APPENDIX 6: Heritage Impact Assessment

FINAL BASIC ASSESSMENT REPORT

APPLICATION FOR ENVIRONMENTAL AUTHORISATION AND PROSPECTING RIGHTS FOR PROSPECTING IN OFFSHORE SEA CONCESSION AREA 6C, NORTHERN CAPE, BY TRANS ATLANTIC DIAMONDS (PTY) LTD

EA Application Ref. No.: NC30/5/1/1/2/14851 PR

September 2026

MARITIME HERITAGE IMPACT ASSESSMENT FOR A PROSPECTING RIGHT APPLICATION IN SEA CONCESSION 6C, NORTHERN CAPE

Assessment conducted under Section 38 (8) of the
National Heritage Resources Act (No. 25 of 1999) as part of an Basic Assessment

Prepared for

Anchor Environmental Consultants

On behalf of

Trans Atlantic Diamonds (Pty) Ltd

Draft for Comment: 3 July 2026

Prepared by

John Gribble (MA)

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EXECUTIVE SUMMARY

TerraMare Archaeology (Pty) Ltd has been commissioned by Anchor Environmental Consultants, on behalf of Trans Atlantic Diamonds (Pty) Ltd to conduct a heritage impact assessment to support an application for prospecting rights to assess the viability of future mining operations in offshore Concession Area 6C.

Concession Area 6C is located 4-5 km offshore of the Northern Cape Coast, about 11km west of the nearest inland town, Koingnaas and 25 km south of Kleinsee. The concession area is approximately 350 hectares in extent.

This desktop maritime heritage impact assessment provides an assessment of the palaeontological, submerged prehistoric and maritime archaeological potential of the concession area, within a study area comprising the concession area buffered by 1 km.

Findings:

According to the palaeontological impact assessment, the seabed sediment that both overlies and comprise the prospecting target resource has the potential to contain a variety of categories of palaeontological material, much of which was reworked during the marine transgression that accompanied the end of the last Ice Age. Fossil material, including petrified fossil wood, Cenozoic shelly macrofauna, fossil bones and teeth and marine shells from the Last Transgression Sequence can be expected.

There have, to date, been no specific studies of the submerged prehistory of the West Coast. However, the archaeological evidence for a hominin presence along the coast during the Earlier, Middle and Later Stone Age is plentiful and the past occupation and exploitation of the adjacent, exposed continental shelf by hominins during periods of lower sea level is likely, suggesting that archaeological sites and materials can be expected on and within the current seabed of the concession area.

The maritime history of the West Coast dates to almost the first days of the Dutch settlement in Table Bay but there are relatively few recorded wrecks in the vicinity of the concession area and no wrecks recorded within Concession area 6C. This receptor was, therefore, scoped out of the assessment.

Conclusions:

This assessment of the heritage resources of Concession Area 6C indicates that there is the potential for the occurrence of palaeontological material, some limited potential for submerged prehistoric archaeological sites or material and a very low likelihood of shipwreck sites or material being present in the seabed sediments to be affected by proposed prospecting activities.

Because of the non-renewable nature of heritage resources, avoidance is the preferred mitigation option, and while this is possible in the case of shipwreck sites, it is unlikely to be possible to achieve in respect of palaeontological or submerged pre-colonial archaeological material.

Although seabed prospecting in Concession Area 6C may result in the destruction of palaeontological and submerged prehistoric archaeological resources, as Pether (2026)

states, these activities also represent an opportunity to obtain potentially significant fossils and to provide concrete evidence of the pre-colonial occupation of the continental shelf during sea level low stands in the last c.1 million years.

The discovery of an important fossil or prehistoric archaeological artefacts can also generate favourable publicity for Trans Atlantic Diamonds (Pty) Ltd, as an illustration of the potential for the co-operative advancement of science and knowledge.

It is recommended, therefore, that the Environmental Mamagement Programme (EMPr) for the proposed prospecting, includes a requirement:

- For the collection of fossils and pre-colonial archaeological material from the recovered prospecting samples; and
- That all relevant Trans Atlantic Diamonds staff and contractors are informed during Environmental Awareness Training of the need to watch for such material during the processing prospecting samples, and that they are provided with information about how to identify both fossils and prehistoric stone artefacts.

In respect of grab and vibrocore samples, fossil or pre-colonial archaeological material may be found during the processing of the samples. This material may be obvious, such as petrified bone and teeth and shell casts, usually phosphatic or flaked stone.

All recovered material of potential interest must have the details of context recorded and be kept for identification by an appropriate palaeontological or archaeological specialist and if significant, to be deposited in a curatorial institution such as the Iziko South African Museum.

The identification of extralimital, Agulhas/Algoa "subfossil" shell species in the loose shells of the Last Transgression Sequence requires a level of seashell knowledge. The best outcome for a set of cores is that they are the subject of a detailed study, such as for a B.Sc. Honours or M.Sc. project, with radiocarbon dates. It is possible that a core or two might intersect rarely preserved lagoonal deposits which are important for providing points on the sea-level curve applicable to the West Coast.

In respect of drill samples, as part of the normal sampling process, the material crossing the oversize screen must be monitored for the occurrence of the various fossil types and for pre-colonial lithic artefacts. Where noted, these should be collected for later identification and evaluation.

Data to be recorded during fossil and artefact collection must include the following: date, vessel, company name, sample number, collector's name, position (co-ordinates), water depth, sample subsurface depth and a brief description and photographs of the recovered material. This information should be accompanied by:

- A copy of the graphic log of the sample drill hole showing the vertical sequence of units and the estimated location of the fossil in the sequence; and
- A map of the fossil finds in the particular sampling area, such as a contoured multibeam bathymetric image showing the context of samples in relation to the bedrock topography and sediment bodies.

During all operations, personnel can send queries and images by email to an appointed palaeontologist for evaluation and prompt feedback.

Collected samples are to be temporarily stored by Trans Atlantic Diamonds.

When a collection of fossil or pre-colonial archaeological material has been accumulated, the appointed palaeontologist and/or archaeologist should undertake the identification and evaluation of the material and compile the report for submission to SAHRA. The Environmental Manager/Officer) is to liaise with the appointed palaeontologist and/or archaeologist on the progress of the fossil and artefact collection and the scheduling of the evaluation.

Please note that the prospecting company must, in advance of prospecting activities, apply to SAHRA for a general permit to destroy, damage, excavate, disturb and collect fossils identified during prospecting, as per the NHRA.

If shipwreck material is identified in the concession area, the find must immediately be reported to SAHRA who will make arrangements to assess the significance of the find and decide on how best to deal with it.

It is our reasoned opinion that, provided the recommendations to mitigate and offset potential impacts are implemented, the proposed prospecting in Concession Area 6C is likely to have relatively minor impacts on palaeontological, submerged prehistoric and maritime and underwater cultural heritage resources and can be considered to be archaeologically and palaeontologically acceptable.

STATEMENT OF INDEPENDENCE

I, John Gribble, declare that:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- There are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing any decision to be taken with respect to the application by the competent authority; and the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24(F) of the Act.

Signature of the specialist

TerraMare Archaeology (Pty) Ltd

Name of company (if applicable):

3 July 2026

Date

CONTENTS OF THE SPECIALIST REPORT – CHECKLIST

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
(a) details of the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a *curriculum vitae*;	Preface pages and Appendix 1
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Page 8
(c) an indication of the scope of, and the purpose for which, the report was prepared;	Section 4: Terms of Reference
(cA) an indication of the quality and age of base data used for the specialist report;	Section 6: Methodology
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 8: Impact Assessment
(d) the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 5: Methodology
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives;	Section 7 & 8: Impact Assessments
(g) an identification of any areas to be avoided, including buffers;	Section 8: Impact Assessment
(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Figure 3-5, 8 & 9, Plate 7
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 6.5: Limitations
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment, or activities;	Section 10: Conclusions & Recommendations
(k) any mitigation measures for inclusion in the EMPr;	Section 10: Impact Assessment
(l) any conditions for inclusion in the environmental authorisation;	Section 10: Impact Assessment
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A
(n) a reasoned opinion— i. as to whether the proposed activity, activities or portions thereof should be authorised; iA. Regarding the acceptability of the proposed activity or activities; and	Section 10.1: Conclusions & Recommendations

ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr or Environmental Authorization, and where applicable, the closure plan;	
(o) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/A
(p) any other information requested by the competent authority	N/A
Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	No such gazetted protocol exists for heritage resources. Heritage Western Cape and SAHRA minimum standards for Heritage Impact Assessments have been applied.

GLOSSARY

Archaeology: Remains resulting from human activity which are in a state of disuse and are in or on land and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures.

Early Stone Age: The archaeology of the Stone Age between 700 000 and 2 500 000 years ago**.**

Heritage: That which is inherited and forms part of the National Estate (Historical places, objects, fossils as defined by the National Heritage Resources Act 25 of 1999.

Holocene: The most recent geological time period which commenced 10 000 years ago.

Hominin: A member of the tribe Hominini which comprises those species regarded as human, directly ancestral to humans, or very closely related to humans.

Late Stone Age: The archaeology of the last 20 000 years associated with fully modern people.

Marine Isotope Stages: Alternating warm and cool periods in the Earth's paleoclimate, deduced from oxygen isotope data reflecting changes in temperature derived from data from deep sea core samples.

Middle Stone Age: The archaeology of the Stone Age between 20 000-300 000 years ago associated with early modern humans.

Pleistocene: A geological time period (of 3 million – 10 000 years ago).

Quaternary: The current and most recent of the three periods of the Cenozoic Era spanning the period from ± 2.5 million years ago to the present.

SAHRA: South African Heritage Resources Agency – the compliance authority which protects national heritage.

ABBREVIATIONS

asl	above sea level
bsl	Below sea level
DBM	De Beers Marine
DMPR	Department of Mineral and Petroleum Resources
EA	Environmental Authorisation
EIA	Environmental Impact Assessment
ESA	Early Stone Age
Fm	Formation
HIA	Heritage Impact Assessment
ka	Thousand years ago
LGM	Last Glacial Maximum
LRS	Last Regression Sequence
LSA	Late Stone Age
LTS	Last Transgression Sequence
Ma	Million years ago
MBES	Multibeam Echo Sounder
MIS	Marine Isotope Stage
MPRDA	Mineral and Petroleum Resources Development Act, 2002 (No. 28 of 2002)
MSA	Middle Stone Age
MWP	Meltwater Pulse
NEMA	National Environmental Management Act (No. 107 of 1998)
NHRA	National Heritage Resources Act
SAHRA	South African Heritage Resources Agency
SAHRIS	South African Heritage Resources Information System
UNCLOS	United Nations Convention on the Law of the Sea

*

1 INTRODUCTION

TerraMare Archaeology (Pty) Ltd has been commissioned by Anchor Environmental Consultants, on behalf of Trans Atlantic Diamonds (Pty) Ltd to conduct a heritage impact assessment (HIA) to support an application (EA Application Ref. No.: NC30/5/1/1/2/14851 PR) for a prospecting right to assess the viability of future mining operations in offshore Concession Area 6C.

The application, being made in terms of the Mineral and Petroleum Resources Development Act (No. 28 of 2002), is for Chrome, Copper, Corundum, Diamonds (general), Garnet (abrasive), Gemstones, Gold Ore, Heavy Minerals (general), Iron Ore, Lithium Ore, Platinum Group Metals, Rare Earths, Silver Ore, Titanium Ore and Uranium Ore.

As prospecting is a “Listed Activity” under the 2014 Environmental Impact Assessment (EIA) Regulations, promulgated under the National Environmental Management Act (NEMA, Act 107 of 1998), Environmental Authorisation (EA) from the Competent Authority, in this case the Department of Mineral and Petroleum Resources (DMPR), is required prior to commencement.

The proposed activities are not expected to constitute bulk sampling and are therefore anticipated to trigger only the following listed activities under Listing Notice 1:

- Activity 19A: “The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock of more than 5 cubic metres from (i) the seashore; (ii) the littoral active zone, an estuary or a distance of 100 metres inland of the high-water mark of the sea or an estuary, whichever distance is the greater; or (iii) the sea…”
- Activity 20: “Any activity including the operation of that activity which requires a prospecting right in terms of section 16 of the Mineral and Petroleum Resources Development Act, as well as any other applicable activity as contained in this Listing Notice or in Listing Notice 3 of 2014, required to exercise the prospecting right.”

Accordingly, EA must be obtained through a Basic Assessment (BA) process, during which the potential environmental impacts of the proposed prospecting activities are assessed.

2 LOCATION OF CONCESSION AREA 6C

Concession Area 6C is is approximately 350 hectares in extent and is located 4-5 km offshore of the Northern Cape Coast, about 11km west of the nearest inland town, Koingnaas and 25 km south of Kleinsee (Figure 1).

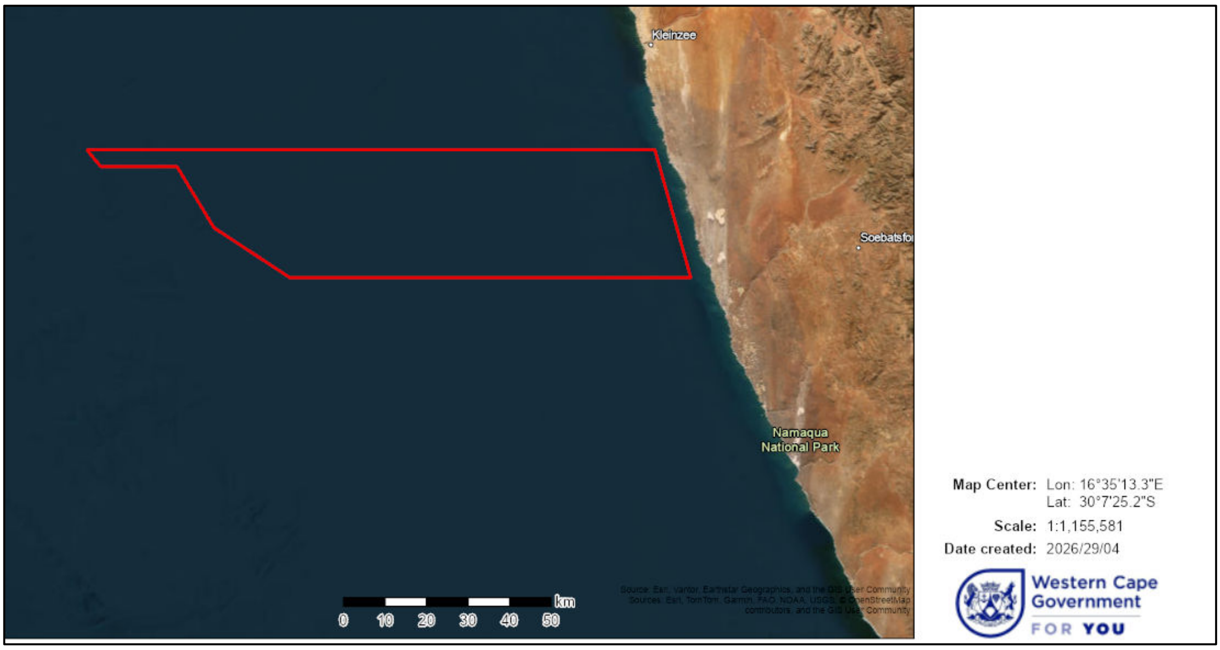


Figure 1: Location of Marine Concession Area 6C.

The co-ordinates of the boundary points of the Concession Area are provided in Table 1 below:

Table 1: Co-ordinates of the boundary points of Concession Area 6C

Vertex	Latitude	Longitude
a	30.182314	16.168534
b	30.074266	15.978797
c	29.941495	15.886008
d	29.941499	15.695164
e	29.905389	15.660994
f	29.905369	17.081360
g	30.182299	17.171094
h	30.182314	16.168534

3 PROJECT DESCRIPTION

The principal objective of the proposed prospecting operations is to identify and quantify potential mineral and metal resources in Concession Area 6C, with the aim of evaluating their viability for future extraction and mining activities.

Prospecting will be conducted in four phases and will entail a combination of the following non-invasive and invasive activities. Some of which are illustrated in Plate 1 below:

- Phase 1:
  - Desktop Study (non-invasive);
  - Geophysical survey and seafloor mapping using a dedicated survey vessel (non-invasive);
  - Data acquisition and synthesis, and geological modelling (non-invasive).
- Phase 2:
  - Van Veen grab sampling (part of ecological baseline survey) (invasive)
  - Core sampling using either a Vibracore, Gravity core or Sonic core (invasive)

- Phase 3:
  - Drill sampling using a specialised drilling tool (invasive)
- Phase 4:
  - Feasibility study and resource estimation (non-invasive).

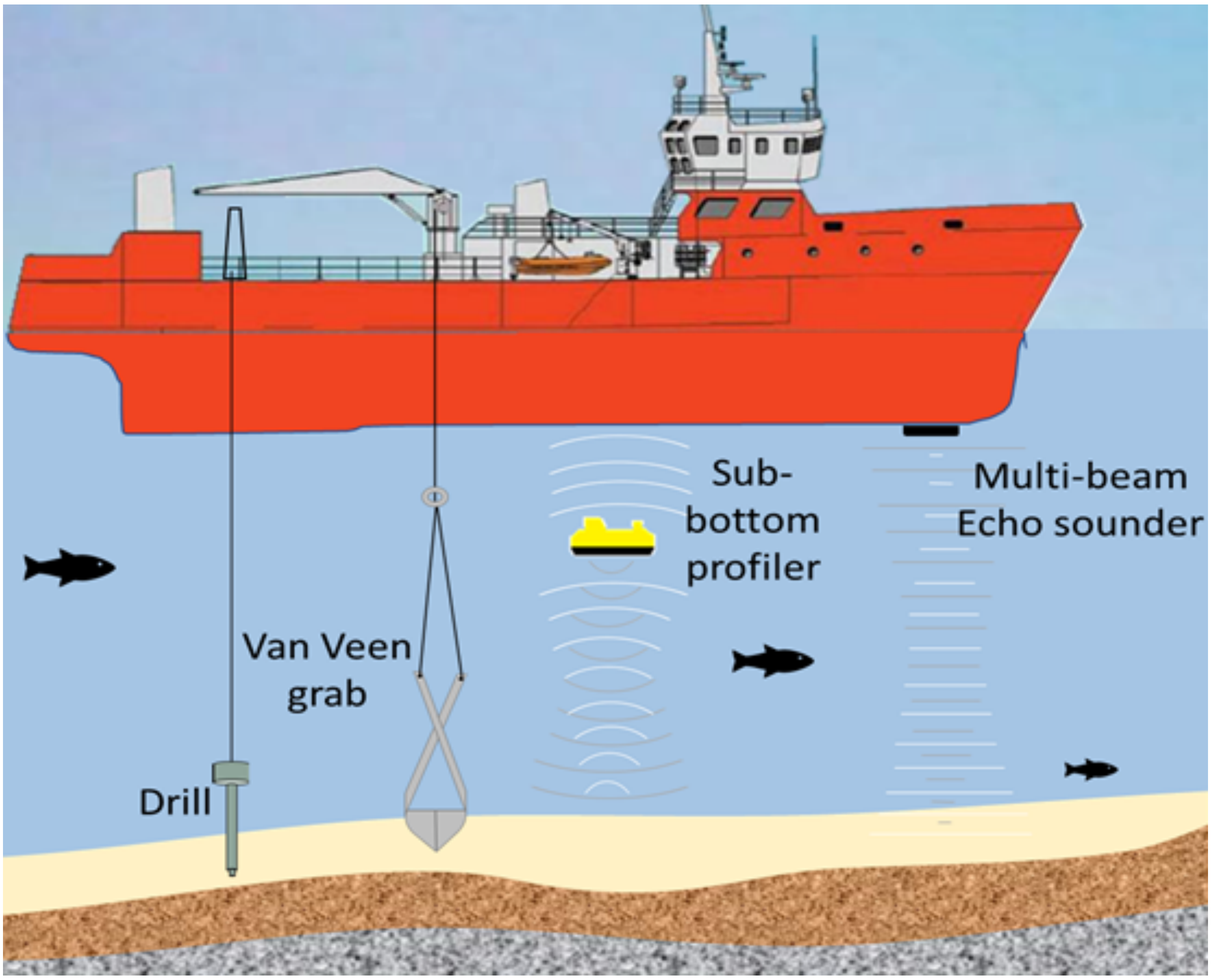


Plate 1: Illustration of some of the sampling methods that will be used in the Phase 1-3 prospecting activities.

The sea-based prospecting activities amongst those listed above will be conducted using a dedicated survey vessel, such as the example shown in Plate 2.

The total seabed surface area expected to be disturbed by the invasive activities during Phases 2 and 3 is approximately 7 507 m² (0.75 ha).

3.1 Desktop Study

A comprehensive desktop study will be undertaken, to review available literature, geological data, and previous exploration information to understand depositional environments, sediment stratigraphy, and mineral potential within Concession Area 6C. This will inform the identification of target sites and support the design of an efficient prospecting programme that minimises environmental impacts and costs.

Plate 2: An example of a vessel that could potentially be used for prospecting and exploration (Image source: Ship-Technology.com).

3.2 Geophysical Surveys

Geophysical surveys will be conducted to collect high-resolution bathymetry data using a high-frequency multibeam echo sounder (MBES), mid-frequency sub-bottom profiler, and magnetometer, along survey lines spaced between 100 m and 1000 m apart throughout the concession area (see Plate 3).

These technologies utilise sound pulses aimed at the seabed and reflected back to a transponder to develop a profile of the seabed and to map buried geological structures

This process does not disturb the seabed and the results are used to identify target sampling areas, sensitive zones to avoid, and to inform drilling methods and mining vessel design. This phase will be followed by data acquisition and synthesis and geological modelling.

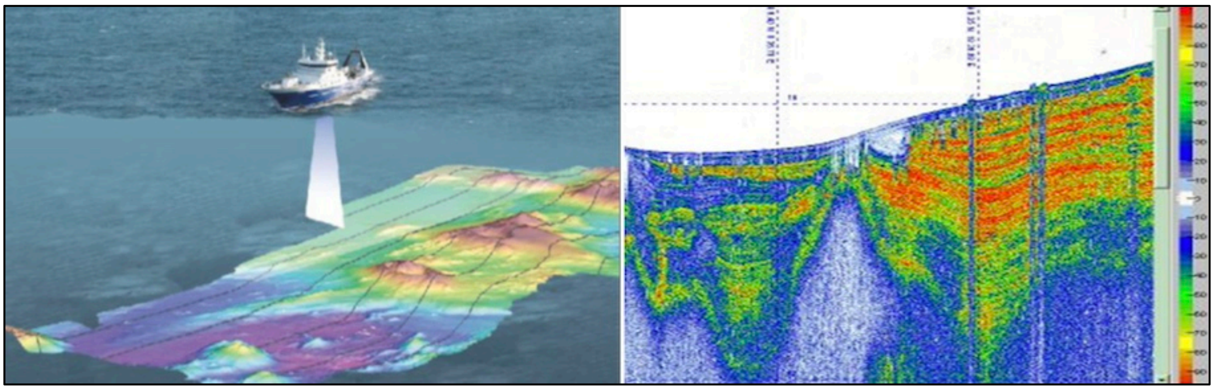


Plate 3: Examples of swath bathymetry (left) and sub-bottom profiler (right) data.

Surveys will be conducted using a dedicated survey vessel (see Plate 2) over a period of suitable, calm sea and weather conditions. The survey speed of a survey vessel is typically 120 km/day in an offshore setting.

The vessel will carry a hull-mounted multibeam echo sounder (MBES) and a Topas sub-bottom profiler system that are designed to collect high-resolution acoustic data) and no physical or environmentally destructive impacts are anticipated for this sampling method. Potential noise or sound impacts on biota will be considered.

The information collected during the acoustic survey will be reviewed by both the geologist and the Environmental Control Officer/ Scientific Officer to identify target areas for sampling, any areas that need to be avoided and to inform the appropriate core sampling and drilling method that must be implemented.

3.3 Van Veen Grab Sampling

The collection of seabed sediment samples for biological, environmental and geotechnical studies will be undertaken using a clamshell bucket, known as a Van Veen grab. A Van Veen grab with a sampling capacity of approximately 50 kg will be used to collect samples at between 20 and 50 sites, at a maximum sampling rate of 30 samples per day (see Plate 4).

The grab can penetrate the seabed to depths of 20 to 50 cm and collects surficial sediment samples that will be subjected to subsampling.

Geotechnical subsamples will be frozen on recovery and sent to a laboratory to test for shear strength, grain size composition, etc. and will be used to determine the geological units of the seafloor.

The grab sampling will disturb a total surface area of 5 square meters (m^2) and the total volume of samples collected will be 1.5 cubic meters (m^3).

Plate 4: Examples of clamshell grab being deployed (Source: https://ets.wessexarch.co.uk/recs/how-we-study-the-seafloor/geological-methods/# and https://www.researchgate.net/publication/363275000_You%27re_going_to_do_What_Where_Challenges_for_resource_estimation_on_the_Chatham_Rock_Phosphorite_Project/figures?lo=1).

3.4 Core Sampling

Geotechnical core samples will be collected at 100-200 sites across the concession area using either vibracoring, gravity coring or sonic coring (Plate 5). Core samples are analysed to determine the sea floor geology (types of material present, i.e. sand, gravel and/ or rock and the hardness of the rock), topography (trenches or elevations) and sediment stratigraphy (how sand and rock are layered).

All the above coring methods work on the principle of sinking a sleeve or casing into the seabed and then withdrawing it, containing a core of the various sedimentary layers encountered. Once recovered to the survey vessel, each sleeved core sample is capped and sealed, enabling it to be easily handled and stored on board for later analysis ashore.

The type of coring used will depend on the geological formations of the seafloor, which will have been established from the results of the geophysical survey.

The diameter of the core samples extracted during these prospecting activities will be approximately 10 cm and the corers will penetrate to depths of between 3 and 8 m, depending on the seabed substrate. The volume per core is estimated at 0.024 m^3.

The collection of 200 cores will take approximately ten workdays. Sampling work will be restricted to the area between the western boundary of the concession area and the 20 m contour.

The core samples will disturb a total surface area of 1.57 m^2, while the total volume of samples that will be collected by the cores will be 4.71 m^3.

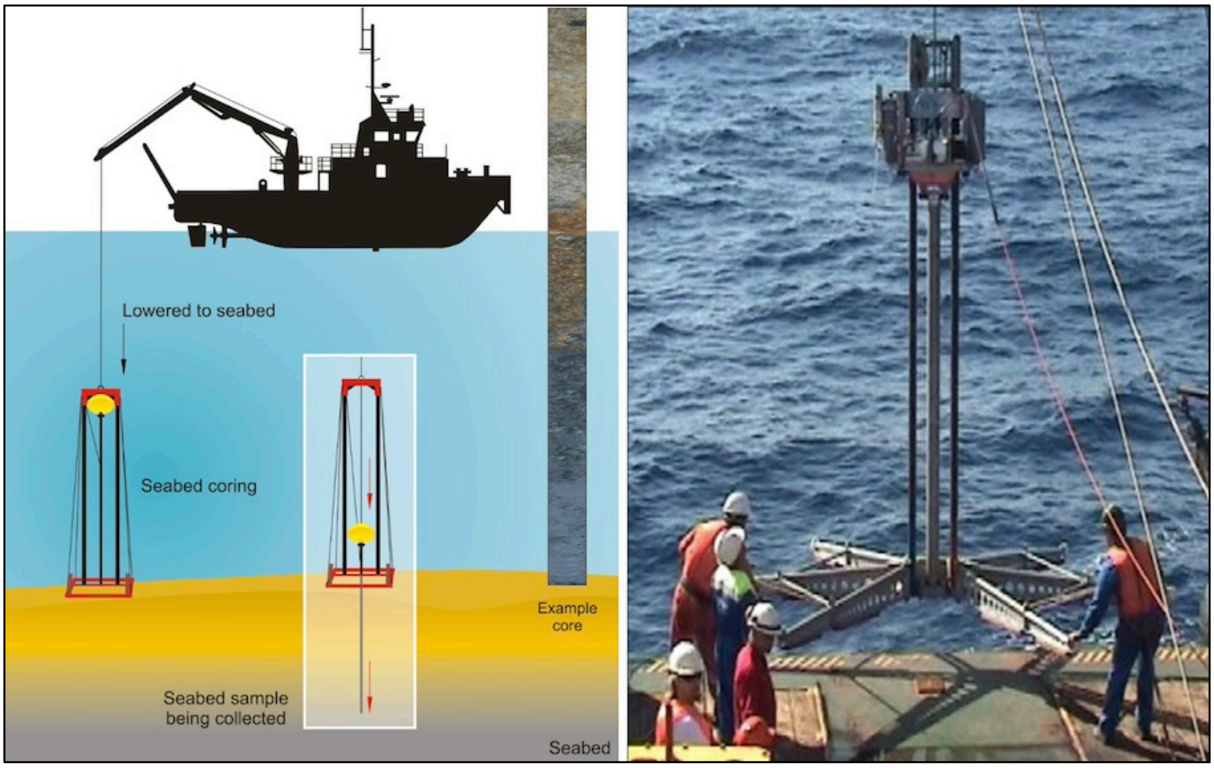


Plate 5: Vibrocore system (Sources: Wessex Archaeology / https://ets.wessexarch.co.uk/recs/how-we-study-the-seafloor/geological-methods/ (left) and SRK (right))

3.5 Drill Sampling

In addition to the coring, prospective mineral targets will be analysed by a uniquely designed drill tool that can dredge gravel from the seabed (see Plate 6). Pending the final tool design, the drill bit footprint will be between 3 and 5 m in diameter and the expected average sample depth will be 3 m, although the drill is designed to drill up to 12 m into the seabed if required. Sample volumes are anticipated to be in the range of 9 to 15 m^3 per sample.

The recovered material will be processed onboard by a processing plant, and tailings will be discarded overboard.

It is anticipated that a total of 150 initial and 150 follow-up drill samples will be required, which together will cover a surface area of 1500 m^2 (based on the worst case of a 5 m^2 diameter drill). These samples will be spaced at roughly 300 m apart from north to south.

Only if the follow-up samples indicate there could be a potential resource, will resource development commence. A potential resource area of not larger than 500 m x 300 m will require an additional 60 samples, spaced on a 50 m grid. Approximately 20 resource development areas will be required which equates to 1 200 samples with a total surface area of 6 000 m^2 based on the worst case of a 5 m^2 diameter drill).

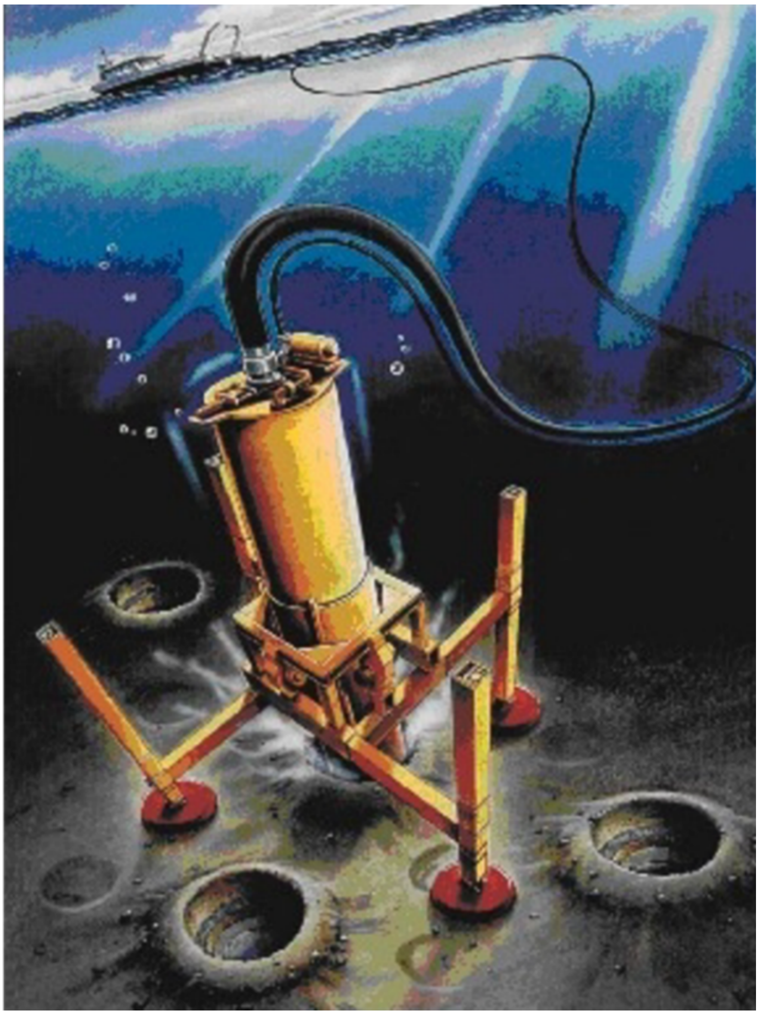


Plate 6: An artist's impression of a sampling drill tool with a drill bit footprint of 3 m^2.

The total seabed surface area that will be disturbed by prospecting activities during Phases 2 and 3 is estimated at 7507 m^2 or 0.75 ha, which equates to 0.0005% of the total area of Concession Area 6C.

The survey and sampling information acquired during prospecting activities will be used to understanding the seafloor topography, resource evaluation and to determine if diamond or other mineral mining within Concession Area 6C is economically viable. The information will also be used to inform the construction of the mining vessel and to identify areas for mining.

3.6 Feasibility Study and Resource Estimation

Should Phases 1, 2 and 3 yield positive results, a feasibility study will be conducted to assess the likely size of the mineral resource and the economic viability of mining in the concession area. This will be a desktop study and will consider the data collected as part of the prospecting activities.

4 TERMS OF REFERENCE

As part of the BA process, Anchor Environmental Consultants, on behalf of Trans Atlantic Diamonds (Pty) Ltd, has appointed specialists to assess the potential risks of prospecting on the marine environment, heritage resources, commercial fisheries and socio-economic resources within Concession Area 6C.

TerraMare Archaeology has been commissioned to produce a maritime HIA to identify heritage resources which may be impacted by prospecting activities in the concession area, to assess their significance and provide recommendations for mitigation, as required by the NEMA, as amended.

This document therefore includes the following, desk-based assessments:

- An assessment by a suitably qualified palaeontologist of the potential for palaeontological features and material in the concession area;
- A consideration of the potential for the presence of submerged and other pre-colonial archaeological sites or materials in or on the seabed of the concession area; and
- A literature review to assess the potential for maritime archaeological sites in the concession area.

The results of the studies listed above are integrated in this HIA report, along with an assessment of the sensitivity and significance of any heritage resources, an evaluation of the potential impacts on them arising from prospecting activities in Concession Area 6C, and recommendations for measures to mitigate any negative impacts of these activities on them.

The HIA will meet the requirements of the South African Heritage Resources Agency's (SAHRA) minimum standards for HIAs and Appendix 6 of the EIA Regulations (2014 as amended) and must be submitted for comment to SAHRA, the relevant statutory commenting body under the NEMA, as part of the BA process.

4.1 The Author

John Gribble has an MA (UCT, 1989), in archaeology and has been working in cultural resource management since the early 1990s. He has worked in both the regulatory and commercial heritage management fields: the former during 13 years at the National Monuments Council / South African Heritage Resources Agency (SAHRA), and the latter as both a terrestrial and maritime archaeological consultant in South Africa and the UK.

He holds archaeological accreditation with the Association of Southern African Professional Archaeologists CRM section (Member #43) as follows:

- Principal Investigator: Maritime Archaeology and Colonial Archaeology; and
- Field Director: Stone Age Archaeology.

A signed statement of independence is included above, and the author's CV is attached as Appendix 1.

5 RELEVANT LEGISLATION

5.1 National Heritage Resources Act (No 29 of 1999)

The National Heritage Resources Act (NHRA) came into force in April 2000 with the establishment of SAHRA, replacing the National Monuments Act (No. 28 of 1969 as amended) and the National Monuments Council as the national agency responsible for the management of South Africa's cultural heritage resources.

The NHRA reflects the tripartite (national/provincial/local) nature of public administration under the South African Constitution and makes provision for the devolution of cultural heritage management to the appropriate, competent level of government.

Because national government is responsible for the management of the seabed below the mean high water mark, however, the management of maritime and underwater cultural heritage resources under the NHRA does not devolve to provincial or local heritage resources authorities but remains the responsibility of the national agency, SAHRA.

The NHRA gives legal definition to the range and extent of what are considered to be South Africa's heritage resources. According to Section 2(xvi) of the Act a heritage resource is "any place or object of cultural significance". This means that the object or place has aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance.

In terms of the definitions provided in Section 2 of the NHRA, maritime and underwater cultural heritage can include the following sites and/or material relevant to this assessment:

- Material remains of human activity which are in a state of disuse and are in or on land [which includes land under water] and which are older than 100 years, including artefacts, human and hominid remains and artificial features and structures (Section 2(ii));

- Wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the maritime culture zone of the Republic, a defined respectively in sections 3, 4 and 6 of the Maritime Zones Act, 1994 (Act No. 15 of 1994), and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation (Section 2(ii)); and
- Any movable property of cultural significance which may be protected in terms of any provisions of the NHRA, including any archaeological artefact or palaeontological specimen (Section 2(xxix)).

Of the heritage resource types protected by the NHRA, prospecting in Concession Area 6C has the potential to impact the following:

- Palaeontological features and material, which are defined by the NHRA as the fossilised remains or fossil trace of animals or plants which lived in the geological past
- Submerged pre-colonial archaeological sites and materials; and
- Maritime and underwater cultural heritage sites and material, which are principally historical shipwrecks.

As per the definitions provided above, these cultural heritage resources are protected by the NHRA and a permit from SAHRA is required to destroy, damage, excavate, alter, deface or otherwise disturb any such site or material.

It is also important to be aware that in terms of Section 35(2) of the NHRA, all archaeological objects and palaeontological material is the property of the State and must, if recovered from a site, be lodged with an appropriate museum or other suitable public institution.

5.2 Maritime Zones Act (No 15 of 1994)

South Africa's Maritime Zones Act of 1994 is the national legislative embodiment of the international maritime zones set out in the United Nations Convention on the Law of the Sea (UNCLOS). The Act defines the extent of the South Africa's territorial waters, contiguous zone, exclusive economic zone (EEZ) and continental shelf, which together comprises of some 4.34 million square kilometres of seabed and sets out South Africa's rights and responsibilities in respect of these various maritime zones.

Under the terms of Sections 4(2) and 6(2) of the Maritime Zones Act respectively, "any law in force in the Republic, including the common law, shall also apply in its territorial waters" and "subject to any other law the Republic shall have, in respect of objects of an archaeological or historical nature found in the maritime cultural zone, the same rights and powers as it has in respect of its territorial waters". The NHRA applies, therefore, within South Africa's territorial waters (12 nautical miles seaward of the baseline) and to the outer limit of the maritime cultural or contiguous zone (24 nautical miles seaward of the baseline).

In areas beyond the contiguous zone, in the Exclusive Economic Zone (EEZ), Section 9 of the Maritime Zones Act states that activities undertaken from installations operating within this zone may be subject to the requirements of any law in force in the Republic. Included in the definition of “installation” set out in Section 1(ii) of the Act, is “any exploration or production platform used in prospecting for or the mining of any substance” (S1(ii)(b)).

In terms of the Maritime Zones Act, therefore, the NHRA will apply to the proposed prospecting activities which have the potential to disturb or damage cultural heritage resources located in or on the seabed in Concession Area 6C.

This means the involvement of SAHRA, as a) a commenting body in respect of the NEMA environmental impact assessment process (see below) and b) as permitting authority where impacts to sites or material cannot be avoided and damage or destruction will occur.

5.3 National Environmental Management Act (Act No 107 of 1998)

The National Environmental Management Act (No 107 of 1998) (NEMA) provides a framework for the integration of environmental issues into the planning, design, decision-making and implementation of plans and development proposals that are likely to have a negative effect on the environment.

Regulations governing the environmental authorisation process have been promulgated in terms of NEMA and include the EIA Regulations (GNR R326/2017) and Listing Notices (LN) 1-3 (R327, R325 and R324) that list activities requiring an EA.

As indicated above, the proposed prospecting in Concession Area 6C triggers NEMA Listed Activities 19A and 20 and requires an application for EA that follows the BA process.

The BA process aims to identify and assess all potential environmental impacts (negative and positive) and the BA report should recommend how potential negative impacts can be effectively mitigated and how benefits can be enhanced.

6 METHODOLOGY

This desktop HIA provides an assessment of the maritime and underwater cultural heritage, pre-colonial archaeological and palaeontological potential of Concession Area 6C within the study area defined in Section 5.1 below.

6.1 Archaeological Assessment

This assessment includes a short description of what comprises South Africa’s maritime and underwater cultural heritage and the maritime history of West Coast, and a discussion of potential maritime heritage resources of the concession area within that wider context. This includes potential pre-colonial archaeological sites and materials in offshore, submerged contexts.

The HIA draws information from readily available documentary sources and databases, including a database of underwater heritage resources maintained by TerraMare Archaeology, and from relevant primary and secondary sources and aims to identify as accurately as possible the maritime heritage resources within the concession area.

6.2 Palaeontological Assessment

The assessment of the palaeontology of Concession Area 6c projects was undertaken by palaeontologist Dr John Pether and is attached below as Appendix 2.

The results of the palaeontological impact assessment (PIA), which have been integrated in part into this report in Sections 7.1 and 7.2 below, are based on a desktop study, which included consulting geological maps, literature and palaeontological databases, and published and unpublished records to determine the potential for prospecting to impact on submerged palaeontological resources in Concession Area 6C.

6.3 Maritime Study Area

The study area for this HIA is defined as a 1 km buffer around the boundary of Concession Area 6C indicated in Table 1 above (Figure 2).

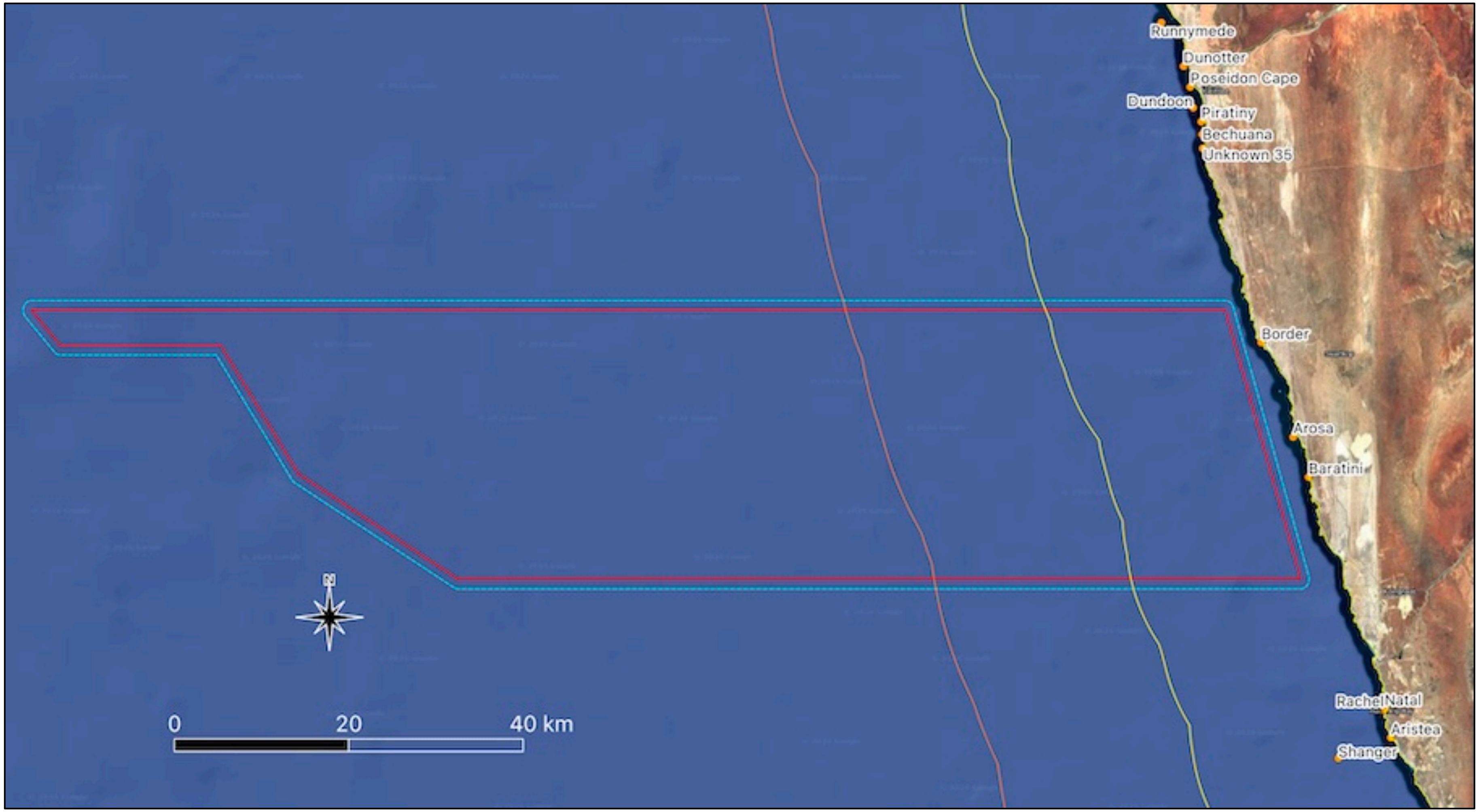


Figure 2: Concession Are 6 C (red polygon) and the surrounding 1 km buffer (dotted blue line) that defines the Study Area used for this HIA (Source: Google Earth).

6.4 Sources of Information

This HIA draws information from the range of primary and secondary sources shown in Table 2 below to describe as accurately as possible the heritage resources within Concession Area 6C and to provide an assessment of the heritage sensitivity of the proposed prospecting.

The sources of information used include a variety of modern and historical maps and charts, published and unpublished archaeological and palaeontological papers, heritage impact assessments that have been undertaken in the vicinity of the concession area, and a database of underwater heritage resources maintained by TerraMare Archaeology.

Table 2: Information sources used in this assessment

Data / Information	Source	Date	Type	Description
Maps	Chief Directorate: National Geo-SpatialInformation	Various	Spatial	Historical and current 1:50 000 topographic maps of the study area and immediate surrounds
Geological chart	Council for Geoscience	Various	Spatial	Current 1:250 000 geological survey chart for the area
Aerial photographs	Google Earth	Various	Spatial	Recent and historical aerial photography of the study area and immediate surrounds
Background data	South African Heritage Resources Information System (SAHRIS)	Various	Reports	Previous impact assessments in the vicinity of the study area
Shipwreck data	Records of historical shipwrecks and casualties	Various	Spreadsheet	Database of historical shipwrecks maintained by TerraMare Archaeology
Background data	Books, journals, websites	Various	Books, journals, websites	Historical and current literature describing the study area and any relevant aspects of cultural heritage.

In addressing the palaeontology, Pether (2026) used the considerable marine geological literature generated by offshore ecological research and resource exploration activities, supplemented by his personal observations of fossils from the West Coast shelf during exploration sampling for diamonds. The contributions relevant to this assessment are cited in the normal manner as references in the text and listed in Section 11 below.

6.5 Limitations

South Africa's record of maritime archaeological (i.e. shipwreck) resources is based on a mix of information derived mainly from historical documents and secondary sources and from very limited primary sources such as geophysical data and other field-based observations and site recordings.

While every effort has been made to ensure the accuracy of the maritime archaeological information presented below, the reliance on secondary data sources means that there are considerable gaps and inaccuracies in this record and the locations of most of the wrecks referred to in the following sections are approximate. The potential also exists for currently unknown and/or unrecorded maritime archaeological sites to be encountered within Concession Area 6c in the course of prospecting activities.

Direct evidence for submerged pre-colonial archaeological sites and materials on the South African continental shelf is very limited, but sites and materials found in similar offshore contexts elsewhere in the world and the known terrestrial archaeology of the West Coast illustrate the potential for such submerged sites and materials around our coast.

Pether (2026) indicates that the main assumption in respect of palaeontology is that the fossil potential of a formation in the study area will be typical of that found in the region and more specifically, similar to that already observed in the study areas. A limitation on predictive capacity exists in that it is not possible to predict the fossil content of an area or formation other than in such general terms. The information gaps are the proprietary, confidential observations contained in geological reports and logs of the sampling and prospecting that has been undertaken in the prospecting and mining right areas.

6.6 Public Participation

As required by the NEMA, a public participation exercise will take place as part of the BA process during which public comment will be sought on the draft BA Report, including all draft Specialist Impact Assessments.

In addition to any other identified Interested and Affected Parties (I&APs), this HIA must be submitted to SAHRA for comment.

Any heritage-related comments received from SAHRA or other I&APs will be dealt with and incorporated into the revised HIA.

7 UNDERWATER CULTURAL HERITAGE

South Africa has a rich and diverse underwater cultural heritage. Strategically located on the historical trade route between Europe and the East, South Africa’s rugged and dangerous coastline has witnessed more than its fair share of shipwrecks and maritime dramas in the last 500 years.

According to SAHRA’s records, at least 2,900 vessels are known to have sunk, or been wrecked, abandoned or scuttled in South African waters since the early 1500s. This does not include the as yet unproven potential for shipwrecks and other sites that relate to pre-European, Indian Ocean maritime exploration, trade and interactions along the South African east coast, or the potential for wrecks of vessels which simply disappeared between Europe and the East to be present in our waters.

Our coastal maritime heritage also includes a largely unexplored, but increasingly acknowledged submerged pre-colonial element, consisting of prehistoric terrestrial archaeological sites, materials and palaeolandscapes which are now inundated by the sea, as well as palaeontological, fossil material in the bedrock which underlies the seabed, and within seabed sediments themselves.

This assessment considers the potential for palaeontological resources, submerged pre-colonial archaeological resources, and historical shipwrecks in Concession Area 6C.

7.1 Geological Setting

The following sections related to geological setting and palaeontological heritage are taken directly from Pether's 2026 palaeontological impact assessment for Concession Area 6C which is attached to this HIA report as Appendix 2.

7.1.1 General Aspects

The inner shelf of Concession Area 6C slopes relatively steeply seawards down to the very gentle slope developed across the middle and outer shelf (Plate 7 and Figure 3).

The inner-shelf bedrock is comprised of the Precambrian "basement rock" gneisses and metasediments of the Namaqualand Metamorphic Province (Figure 3), dating to 1200 – 800 million years ago (Ma). These Precambrian bedrock formations are not of palaeontological concern.

The hard seabed geology of the continental shelf, beneath unconsolidated sediments, is depicted in Plate 7 and Figure 3 and shows overall successively younger chronological formations seawards as the continental margin was built out by the muds and sands delivered to the opening Atlantic Ocean by the numerous rivers which eroded the subcontinent since the breakup the supercontinent Gondwana 130-120 Ma.

The Cretaceous and Paleogene units comprise the main bulk of the continental shelf and are succeeded by cappings of overlapping Miocene and Pliocene units.

The eroded surfaces of the inner-shelf bedrock and the offshore Cretaceous, Paleogene and Miocene formations are the bottom or "footwall" to overlying, much younger Quaternary to present-day deposits shown in Plate 7.

For the most part, the Quaternary deposits are a veneer over the continental shelf but are much thicker where they have accumulated in the accommodation space provided by the slope break between the steeper inner shelf and the nearly flat middle shelf where they constitute the "Mudbelt" (Figure 4).

The Mudbelt is a composite feature with a lower portion composed of coarse shallow-water sediments deposited during low sea level, overlain by thick muds accumulated under subsequent deeper water depths. The terrigenous mud was delivered by the Orange/Gariep River and has been transported southwards by the Benguela Undercurrent and has accumulated since about 11 thousand years ago (11 ka) when sea level approached its current level.

The Mudbelt extent and thickness narrows and thins southwards past Concession Area 6C and most of it is located in the shallow portion of the concession area where the muds form the seabed (Figure 4).

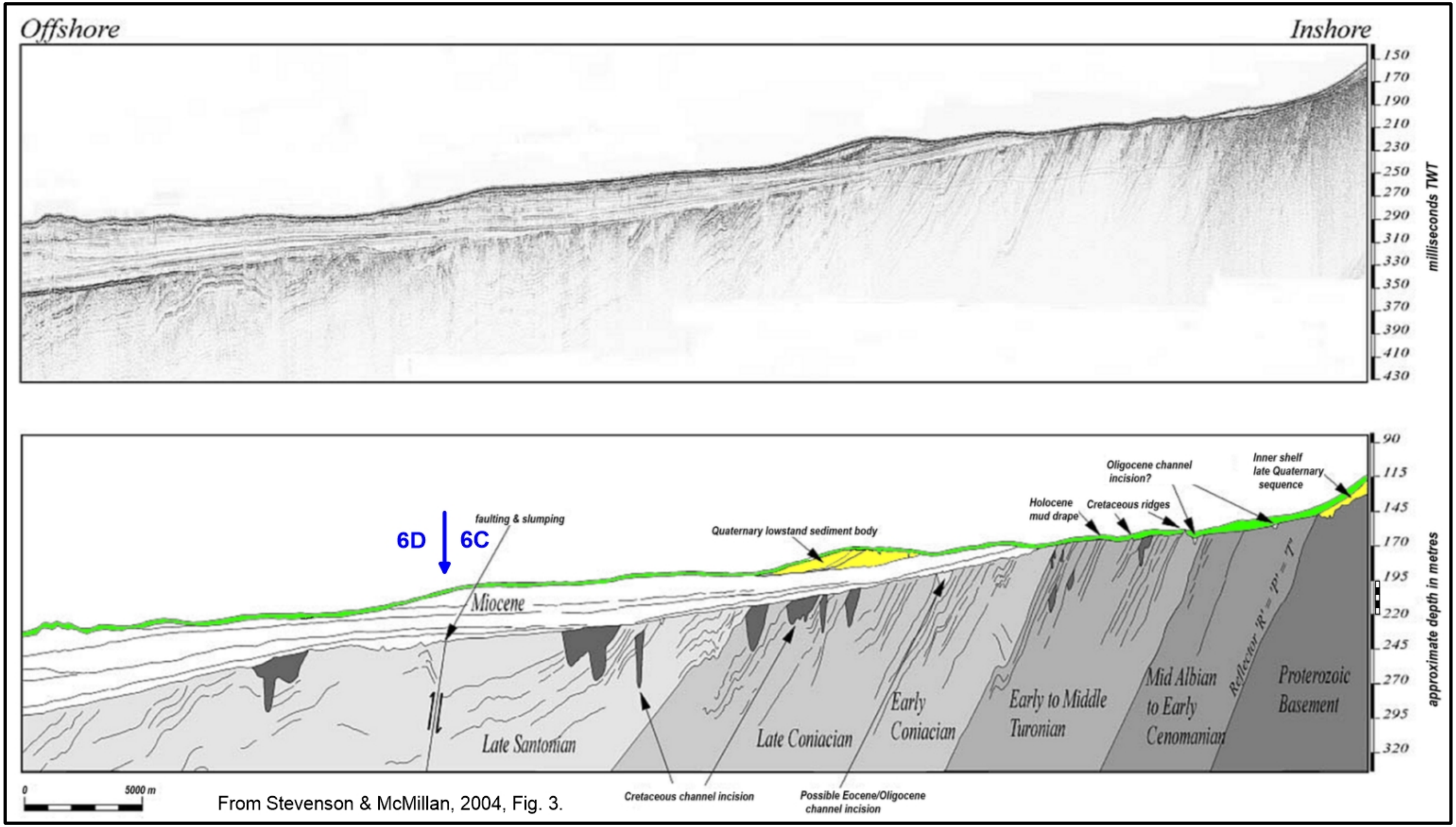


Plate 7: Interpreted geophysical (seismic) profile seawards off Hondeklipbaai showing the Pre-Quaternary geology and the generally thin, overlying Quaternary deposits (in colour).
The section is vertically exaggerated - true Cretaceous reflector dips are only 1.5 degrees (Pether, 2026).

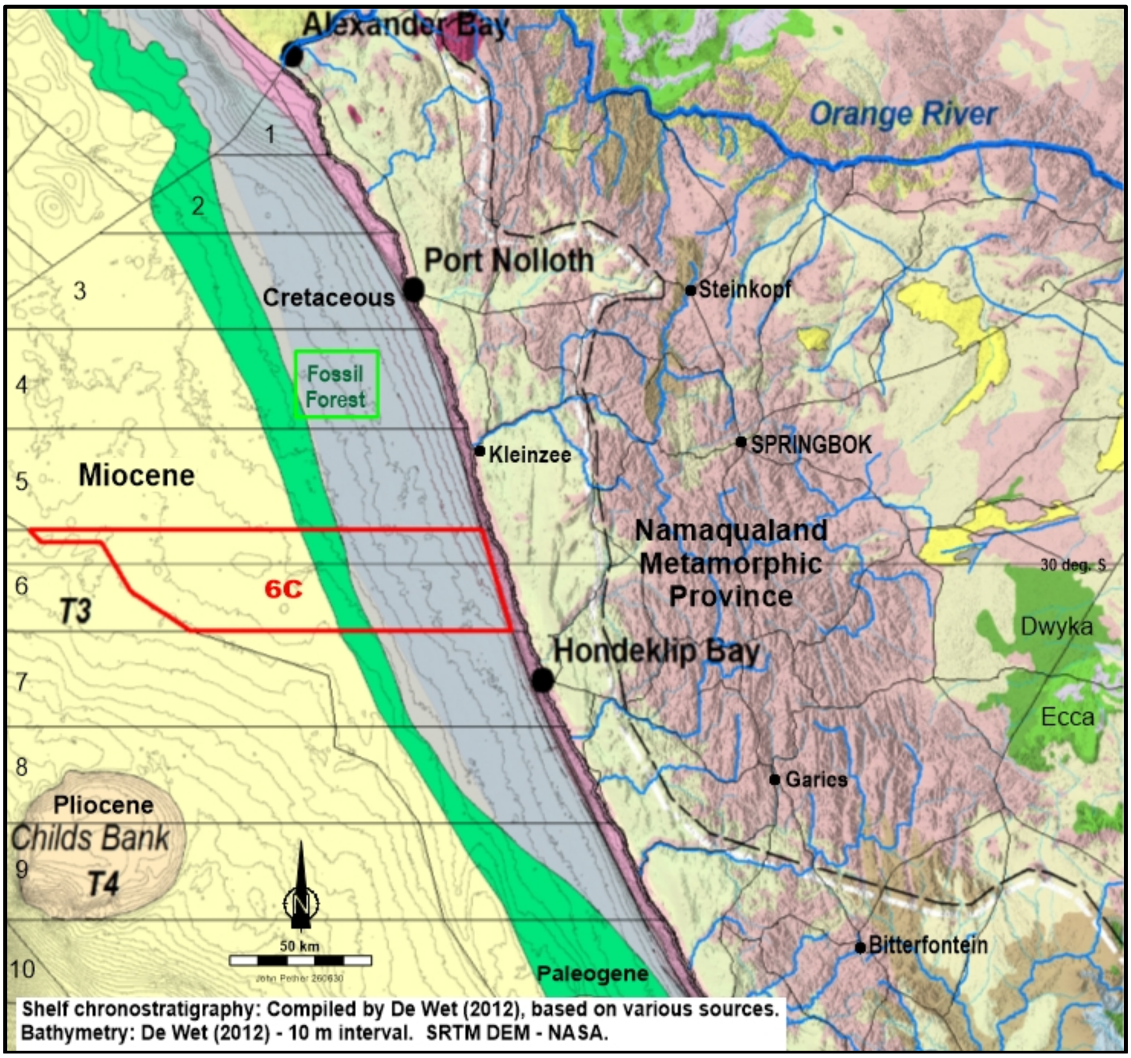


Figure 3: Regional onshore and offshore geological setting of Concession Area 6C (Pether, 2026).

The Quaternary veneer in the shallow half of Concession Area 6C is mainly comprised of terrigenous (land-derived) sands and silts. A large area which is glauconite-rich is identified (Figure 4).

Known as “greensands” due to the colour of the sand grains, glauconite is an iron-rich mineral which forms in the marine environment, infilling the pore spaces in sediments. These greensands have been derived from the erosion and reworking of older formations on the shelf, such as the underlying Paleogene formations.

Further offshore the sediment cover is dominated by the calcareous, sand-sized shells of microfossil foraminifera, settling out of the water column onto the seabed.

The coarse-scale sediment thicknesses shows an offshore Quaternary sediment body (Figure 4) which corresponds to the lowstand sediment body shown in Plate 7, which was deposited mainly during the Last Ice Age when sea level was about -125 m below sea level.

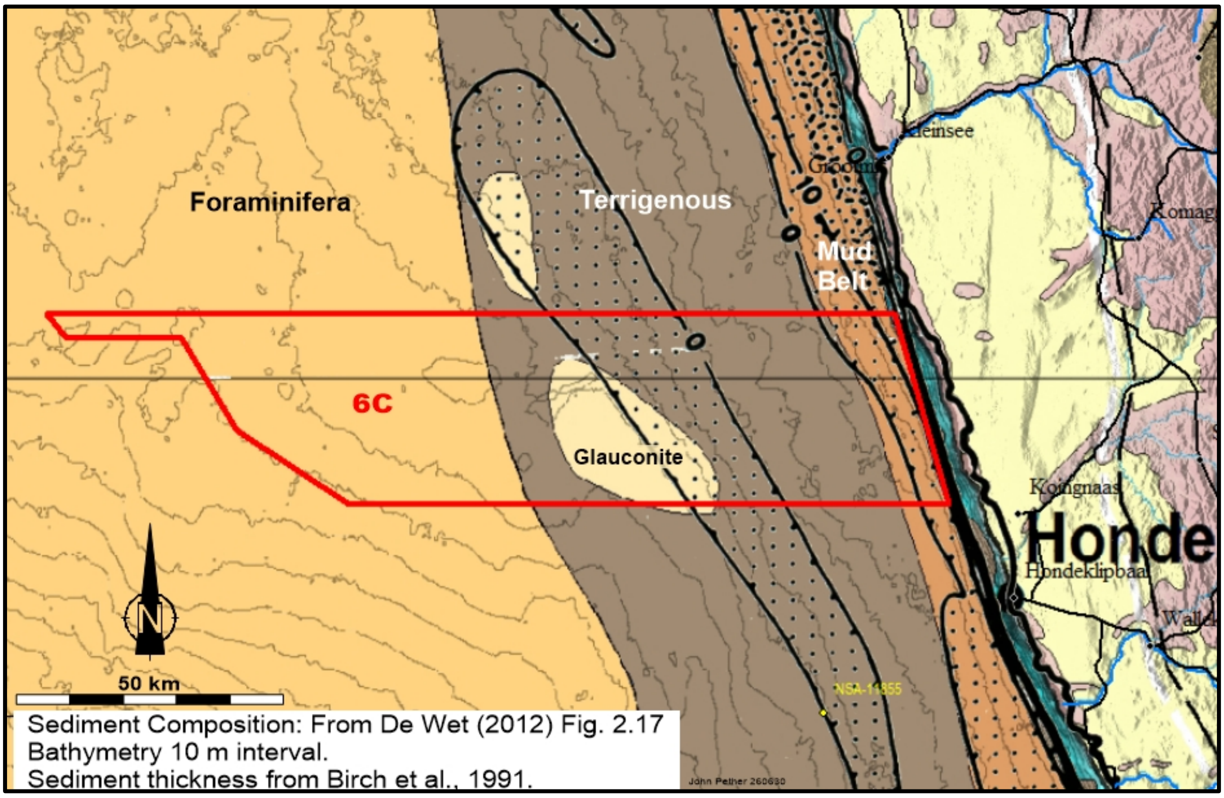


Figure 4: Surficial sediment compositions and Quaternary sediment thickness (Pether, 2026).

7.1.2 Pre-Quaternary Formations

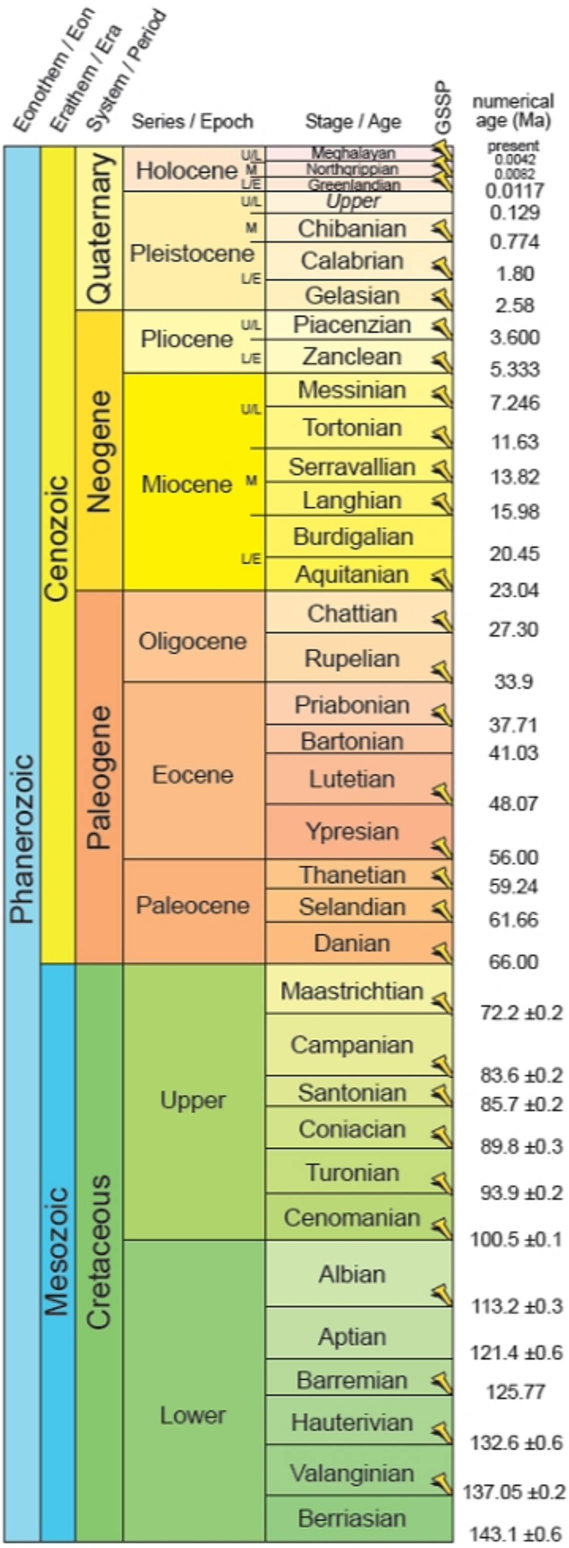
The pre-Quaternary footwall geology shown in Figure 3 is based on very broad-scale, early surveys and is now superseded. The updated offshore geology shown in Figure 5 comes from a published extract (McMillan, 2003) of the unpublished, proprietary map produced by the De Beers Marine (DBM) diamond exploration geologists over many years.

The buried stratigraphy and surface outcroppings are mapped on the basis of geophysical profiles acquired by DBM surveys and geophysical profiles and borehole data from oil and gas exploration (e.g. SOEKOR/PetroSA). The ground-truthing of outcrop and the ages of the formations are based on samples from the seabed obtained during diamond sampling and mining and from vibracoring campaigns specifically intended for stratigraphic and age-control purposes.

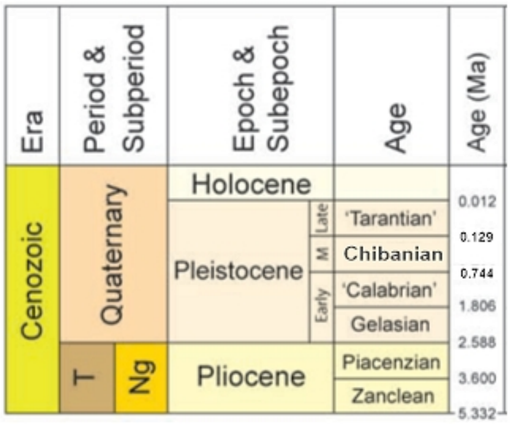
The main difference between Figure 3 and Figure 5 is that the onlapping Miocene formation extends further inshore.

The Cretaceous is subdivided into formations which are named according to their ages in terms of international chronostratigraphic nomenclature shown in Plate 8 below.

Mesozoic and Cenozoic Chronostratigraphy
From: International Commission on Stratigraphy.
Chronostratigraphic Chart 2026/06.pdf



Eonothem / Eon	Erathem / Era	System / Period	Series / Epoch		Stage / Age	numerical age (Ma)
Phanerozoic	Cenozoic	Quaternary	Holocene	U/L	Meghalayan	present 0.0042
				M	Northgrippian	0.0082
				L/E	Greenlandian	0.0117
			Pleistocene	U/L	Upper	0.129
				M	Chibanian	0.774
				L/E	Calabrian	1.80
					Gelasian	2.58
		Neogene	Pliocene	U/L	Piacenzian	3.600
				L/E	Zanclean	5.333
			Miocene	U/L	Messinian	7.246
					Tortonian	11.63
				M	Serravallian	13.82
					Langhian	15.98
				L/E	Burdigalian	20.45
					Aquitanian	23.04
		Paleogene	Oligocene		Chattian	27.30
					Rupelian	33.9
			Eocene		Priabonian	37.71
					Bartonian	41.03
					Lutetian	48.07
					Ypresian	56.00
			Paleocene		Thanetian	59.24
					Selandian	61.66
					Danian	66.00
	Mesozoic	Cretaceous	Upper		Maastrichtian	72.2 ±0.2
					Campanian	83.6 ±0.2
					Santonian	85.7 ±0.2
					Coniacian	89.8 ±0.3
					Turonian	93.9 ±0.2
					Cenomanian	100.5 ±0.1
			Lower		Albian	113.2 ±0.3
					Aptian	121.4 ±0.6
					Barremian	125.77
					Hauterivian	132.6 ±0.6
					Valanginian	137.05 ±0.2
					Berriasian	143.1 ±0.6



Era	Period & Subperiod		Epoch & Subepoch		Age	Age (Ma)
Cenozoic	Quaternary		Holocene			0.012
			Pleistocene	Late	'Tarantian'	0.129
				M	Chibanian	0.744
				Early	'Calabrian'	1.806
					Gelasian	2.588
	T	Ng	Pliocene		Piacenzian	3.600
					Zanclean	5.332

Holocene: The most recent geological epoch commencing 11.7 ka till the present.

Pleistocene: Epoch from 2.6 Ma to 11.7 ka.
Late Pleistocene 11.7–129 ka.
Middle Pleistocene 129–744 ka.
Early Pleistocene 744–2588 ka.

Quaternary: The current Period, from 2.6 Ma to the present, in the Cenozoic Era.
The Quaternary includes both the Pleistocene and Holocene epochs. As used herein, early and middle Quaternary correspond with the Pleistocene divisions, but late Quaternary includes the Late Pleistocene and the Holocene.

Plate 8: Geological Time Scale Terms

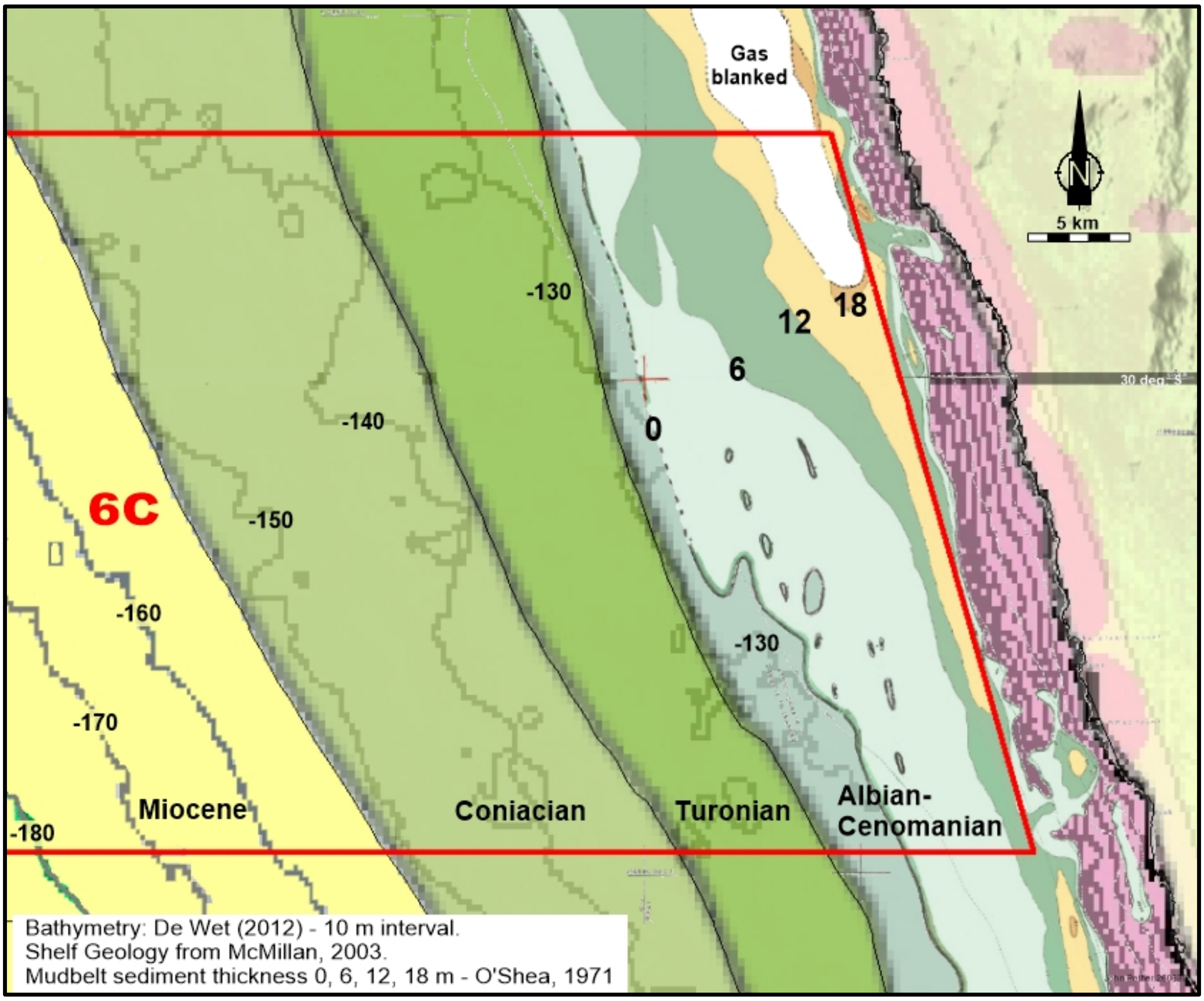


Figure 5: Updated shelf geology showing Cretaceous formations and the thicknesses of the Mudbelt sediments (Pether, 2026).

The Albian to Cenomanian Fm. (~108-97 Ma) is of fluvial origin and consists of white, kaolinitic muds, well-sorted sandstones and well-sorted, sub-angular to sub-rounded, exclusively vein-quartz gravels with kaolinitic matrixes. The kaolinite clays and local silicification indicate advanced weathering under humid climatic conditions. No marine microfossils are present. Worn pebbles of black lignite are derived from this formation.

The Turonian Fm. (~94-92 Ma) is comprised of cycles of thick fluvial muds, locally with incised valley fills and interbedded with thinner grey muds with microfossils indicative of brackish (hyposaline), estuarine environments.

The Coniacian Fm. (~89-86 Ma) is a thick fluvial succession characterised by numerous incised valleys associated with erosion surfaces and subsequent valley fills which terminate in marine incursions, indicate of falling and rising cycles of sea level. Ferruginized sandstones and conglomerates are associated with the major palaeosurfaces and were cemented from groundwater high in dissolved iron, with Fe-oxide precipitated by fluctuation of water table levels beneath the alluvial floodplains. These harder, cemented strata now stand proud as ridges on the seabed (Stevenson & McMillan, 2004).

The Santonian Fm. (~86-83 Ma) is fluvial in origin and also characterised by incised valley fills with brown claystones, minor sandy clays and land-plant microfossils (spores, seeds).

The Palaeogene is represented by Eocene formations of Bartonian age (41-38 Ma) and consists of deep-water green marine clays.

The Miocene Fm. in Concession Area 6C is of Burdigalian age (20-16 Ma) and is pale grey and pale yellow limestone mainly consisting of biogenic carbonate such as forams, bryozoans and shell fragments, with very minor terrigenous input.

In the deeper part of thecConcession area (>-180 m bsl.) unpublished data indicates there are "windows" in the Miocene exposing Santonian and Eocene footwall.

7.1.3 Quaternary Deposits

Figure 5 above also shows the thicknesses of the Holocene Mudbelt which mainly overlies the middle-shelf Albian-Cenomanian footwall and which is thickest in the angle between the steep Precambrian inner shelf and the flat middle shelf, exceeding 18 m thick in the northeastern corner of Concession Area 6C where gas in the sediment has blanked out the echoes from underlying sound (seismic) reflectors.

Also of note are sediment-filled depressions in the Precambrian inner-shelf bedrock opposite the northern and southern corners of the concession area which are often the seaward extensions of buried palaeochannels and river valleys on land on the coastal plain.

For the most part the Quaternary sediments overlying the Cretaceous footwall in the inshore of Concession Area 6C involve only the Last Transgression Sequence (LTS) which was deposited during and subsequent to the last rise in sea level from the Last Glacial Maximum (LGM) lowstand ~20 ka (see Plate 9).

The shoreface of the rising, advancing shoreline is very effective at eroding and redistributing the previous shoreline and dune deposits it encroaches upon, due to the high wave energy impinging on the West Coast. The lower LTS is comprised of basal gravel units left behind in the deepening shoreface and innermost shelf where they were partly reworked during major storms. With ongoing deepening the basal gravels are overlain by an upward-fining unit of pebbly and shelly shelf sands, fine sands, and finally the bioturbated muds of the modern shelf seabed.

Bedrock depressions and sheltered sites landward of high bedrock ridges may include earlier Quaternary marine conglomerates and sandstones as local remnants that escaped erosion during the latest transgression from the LGM low sea level. As shown in Plate 10, the rate of the last deglacial rise in sea level was not uniform, but with periods of slow rise or stillstand succeeded by rapid rises due to pulses of polar meltwaters (Meltwater Pulses, MWPs).

Provided that sediment is available, barrier beaches with spits, lagoons and dunes form on top of the deposits of the previous regression and these deposits are then overstepped and incompletely eroded by the subsequent Meltwater Pulse rapid rise in sea level (Runds *et al*., 2019).

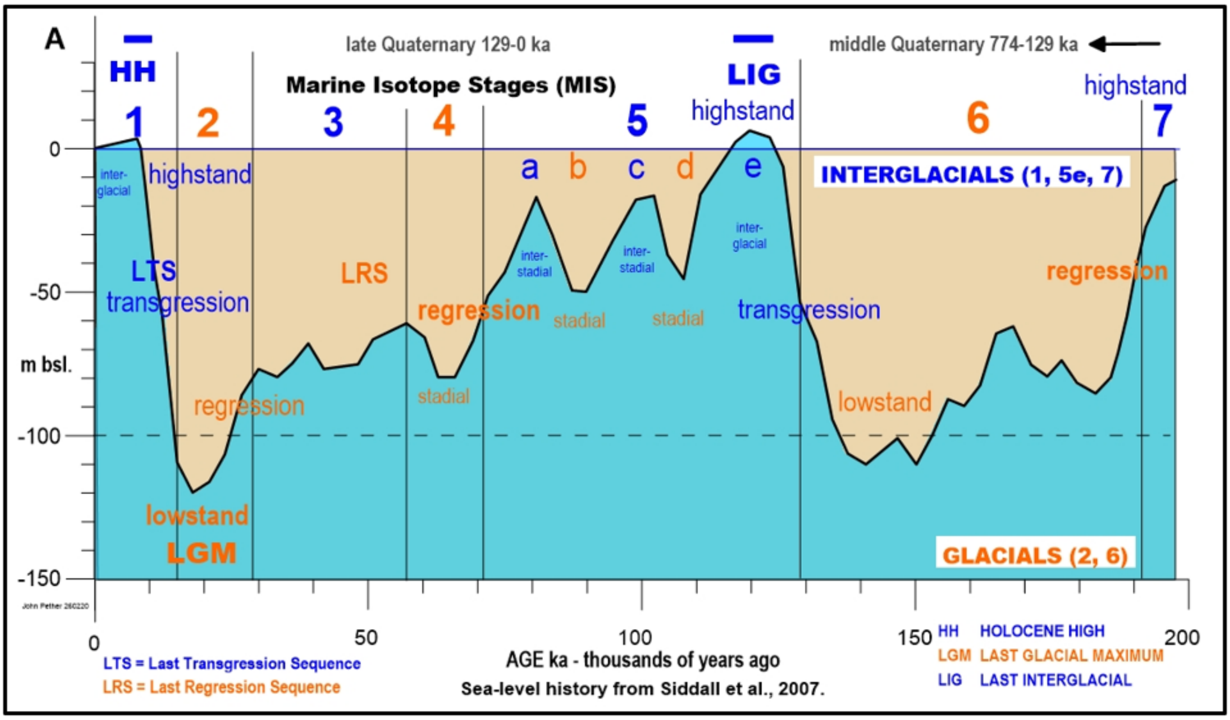


Plate 9: Sea level history and palaeoclimatic nomenclature for the last 200 kyr (Pether, 2026).

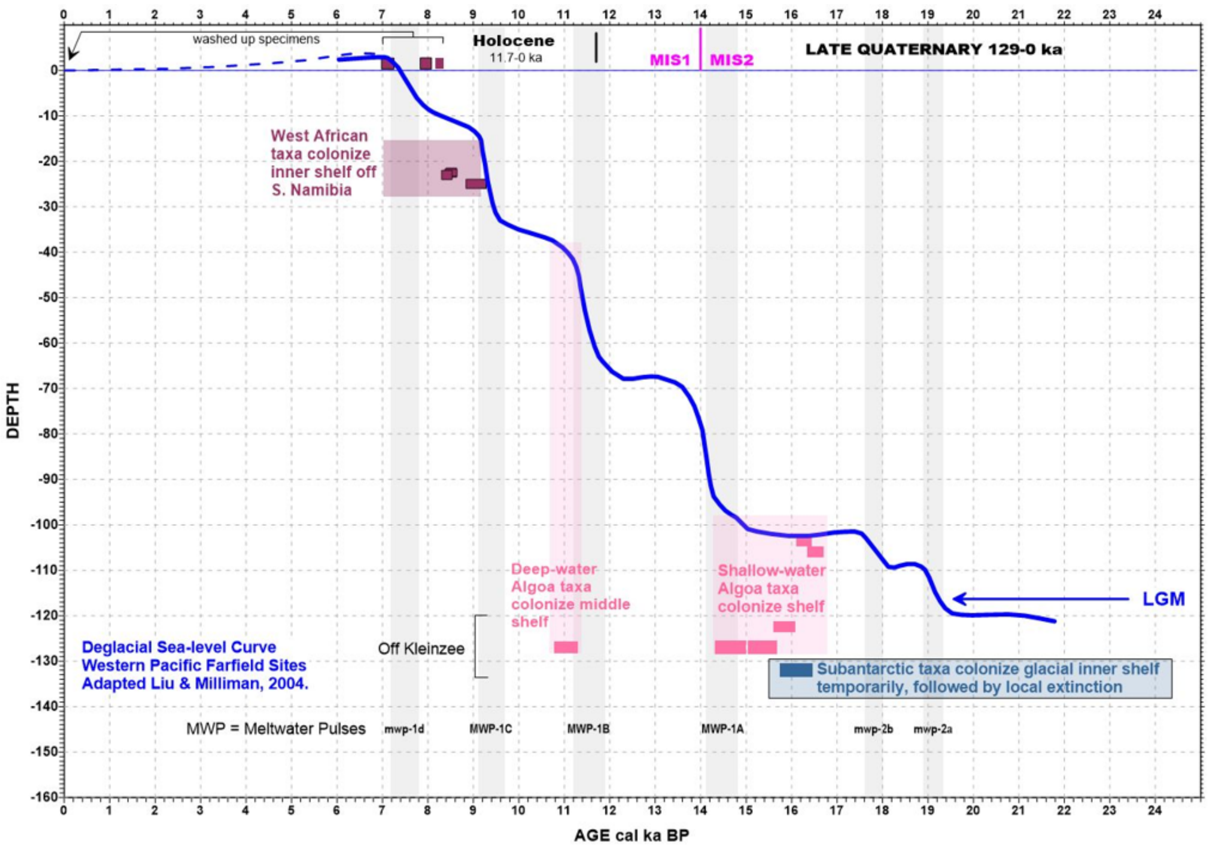


Plate 10: Sea-level curve for the last deglaciation, showing contexts of dated shells from the West Coast Shelf (Pether, 2026).

Based on personal observations there are several permutations for what type and age of deposits might be preserved, which are dependent on the depth/elevation of the site relative to sea-level history and the space within bedrock depressions. The observed beds are sensible in terms of sea-level history and an idealized sequence in a bedrock depression or overstepped elevation interval at ~-100 m depth may include all or some of the following generic units (refer to Plate 9).

1. After ~15 kyr of being on the shore of the MIS 6 lowstand, shoreface gravels and coarse sands were deposited during the MIS5/6 transgression ~135 ka.
2. Succeeding muddy fine sands and muds deposited during the LIG highstand MIS 5e and the continuing higher levels for the remainder of MIS 5 (5d-5a). Subsequent shallowing during MISs 4, 3 and 2 then reworked the deeper-water sediments at -100 m depth, but not totally, as is evident in their preservation in places.
3. Shelly gravels and sandstones deposited during the ongoing regression (MIS 2), constituting the base of the Last Regression Sequence (LRS) dating to 25 ka.
4. Subaerial exposure for ~10 thousand years (kyr) during the LGM and deposition of terrestrial deposits comprising the upper LRS which may include colluvium, pan deposits and dune sands, with land snails, possible animal remains and perhaps archaeological material, capped by a soil and/or incipient calcrete.
5. An erosion surface overlain by the basal gravel of the Last Transgression Sequence (LTS) (MIS 1/2, ~14 ka).
6. Succeeding shelly sand fining up to muddy shelf sand and muds (current interglacial highstand, later MIS 1).

In contrast, the shelf deeper than the LGM sea level lowstand remained submerged and will not include terrestrial deposits. Over much of the middle shelf the Quaternary is a veneer about 0.5 m thick, representing a condensed sequence with a basal winnowed shell lag gradationally overlain by a fining-upwards unit of muddy sand to mud, representing shallow shelf deepening to middle shelf depths. Where accommodation is available thicker deposits are comprised of 2 or 3 such sequences, formed during the last two or three glacial/interglacial sea-level cycles.

7.1.4 Palaeontological Heritage

7.1.4.1 Cretaceous Fossil Wood

Cretaceous fossil wood occurs primarily in the gravels on the flat middle shelf which directly overlie the source Cretaceous formations. Petrified wood is common and includes areas where petrified logs litter the seabed, *e.g.* the "Fossil Forest" protected area (Figure 3).

Sections of silicified tree trunks were encountered during ground-truthing inspection of the seabed from the manned submersible JAGO by De Beers Marine. Specimens obtained via diamond exploration are providing valuable insights into the palaeo climates of the Cretaceous West Coast, when wide, well-watered coastal plains were covered by forests of primitive yellow wood (podocarp) trees (Bamford & Corbett, 1994; Bamford & Stevenson, 2002; Stevenson & Bamford, 2003).

The best samples are those which are minimally abraded and of the largest size that passes through the drill apertures (large cobble to small boulder size), as these should generally be close to their position in the shelf stratigraphic sequence. Abraded, very reworked Cretaceous fossil wood also occurs onshore (Plate 11: Beach cobbles of petrified fossil wood, together with some small cobbles of black lignitic wood.).

Plate 11: Beach cobbles of petrified fossil wood, together with some small cobbles of black lignitic wood.

7.1.4.2 Cenozoic Shelly Macrofauna

The Cenozoic shelly macrofauna comprises black phosphatic shell casts (Plate 12) and more rarely partly intact shells of various ages, mainly of Eocene and early Miocene ages.

During later Neogene and Quaternary times the shelf was dominated by upwelling processes, with high organic productivity and authigenic mineralization of seabed rocks, clays and biogenic particles by phosphatization and glauconization.

Extensive cemented crusts or “hardgrounds” formed on formations exposed at the seabed. Sea level oscillated repeatedly, dropping to ice-age palaeoshorelines as much as 140 m below present sea level.

The hardgrounds were eroded during the ice-age/glacial shallowing episodes, releasing these fossils for incorporation into the LTS gravels.

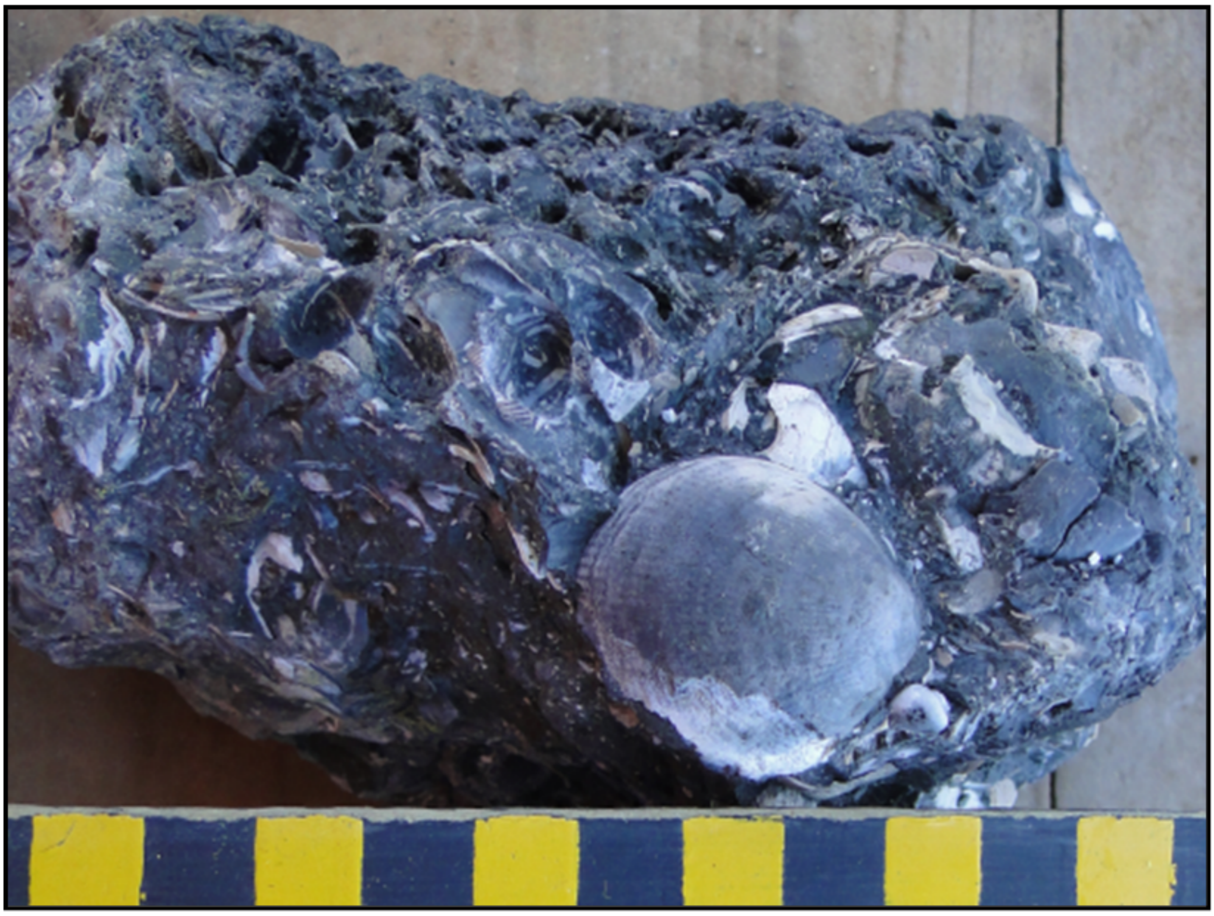


Plate 12: Example of cemented Miocene hardground with shell moulds.

7.1.4.3 Fossil Bones and Teeth

Fossil bones and teeth include the bones and teeth of sharks and other fishes, the skulls of extinct whale species and the occasional remains of land-living animals that roamed the ice-age exposed shelf are also phosphatized and reworked into the latest, loose LTS sediments on the seabed.

A sample of this reworked material turns up in bottom-trawl fishnets, scientific dredging and during diamond-mining operations and the specimens which have been donated to scientific institutions have been invaluable contributions (*e.g.* Bianucci, Lambert & Post, 2007; Bianucci, Post & Lambert, 2007).

All such material should be collected.

7.1.4.4 Shells from the Last Transgression Sequence

Shells from the LTS refers to the "subfossil" shells that occur abundantly in the sediments accumulated on the shelf during the last 20 thousand years as it was submerged to increasing depths. The marine shell fossils which occur in the LTS are predominantly the species expected on the West Coast Shelf, in a deepening-water faunal succession with littoral epifaunal species in the basal gravels, succeeded by infaunal bivalves in clean sands, succeeded by bivalves adapted to dwelling in the capping sulphidic muds. However, unexpected species and "extralimitals" (species beyond their normal home range) are actually quite common.

For instance, the Last Ice Age palaeoshoreline gravels are dominated by a “Venus shell” clam, *Tawera philomela* (Plate 10). This Subantarctic cold-water species, along with others, reached the Cape coast from the mid-Atlantic islands of Tristan da Cunha and Gough, apparently thrived here and then became extinct locally during the last deglaciation (Pether, 1993).

During the subsequent deglaciation/warming, several warm-water species from the south and east coasts “invaded” the western shelf temporarily (Plate 10)). This shows a more marked influence of Agulhas water rounding the Cape and affecting the Benguela System during the global-warming steps of the last deglaciation (Pether, 1994).

These Agulhas extralimitals have mainly been found during diamond exploration sampling off northern Namaqualand off Kleinzee in the inner part of Concession 5C.

7.2 Submerged Prehistory

Since the start of the Quaternary, approximately 2.6 million years ago, the world has been subject to a series of cooling and warming climatic cycles and sea level was mainly lower than it is today.

During the last 900,000 years, during which our tool-making ancestors were colonising much of the world, global sea levels have fluctuated substantially on at least three occasions, the result of increased and decreased polar glaciation. The dropping of sea levels was caused by the locking up in the polar ice caps of huge quantities of seawater as global temperatures cooled.

The most extreme recent sea level drop occurred between circa 20,000 and 17,000 years ago when, during Marine Isotope Stage 2 (MIS) at the height of the last glaciation, the sea was more than 120 m lower than it is today (Waelbroeck *et al*, 2002; Rohling *et al*, 2009). Similar sea level low stands occurred during MIS 4 (~70,000 years ago), MIS 6 (~190,000 years ago), MIS 8 (~301,000 years ago) and MIS 12 (~478,000 years ago).

Each of these low stands would have “added a large coastal plain to the South African land mass” (Van Andel, 1989:133) where parts of the continental shelf were exposed as dry land (see Cawthra *et al*, 2016) (Figure 6). The exposure of the continental shelf would have been most pronounced on the wide Agulhas Bank off the southern Cape coast, and it is estimated that a new area of land, as much as 80,000 km^2 in extent, was exposed during the successive glacial maxima (Fisher *et al*, 2010). Figure 7 gives an indication of the likely extent of the continental shelf exposure on the south and west coasts during the second to last glaciation (MIS 6) during the Middle Stone Age (MSA).

The exposed continental shelf was repeatedly populated by terrestrial flora and fauna, and also by our human ancestors who were dependant on these resources (Compton, 2011), and for periods numbering in the tens of thousands of years, on at least three occasions during the last 500,000 years, covering the latter part of the Earlier Stone Age (ESA), the MSA, and the early Later Stone Age (LSA), our ancestors inhabited areas of what is now seabed around the South African coast. This means that a large part of the archaeological record of the later Earlier, Middle and early Late Stone Age is located on the continental shelf and is now “inundated and for all practical purposes absent from [that] record” (Van Andel, 1989:133-134).

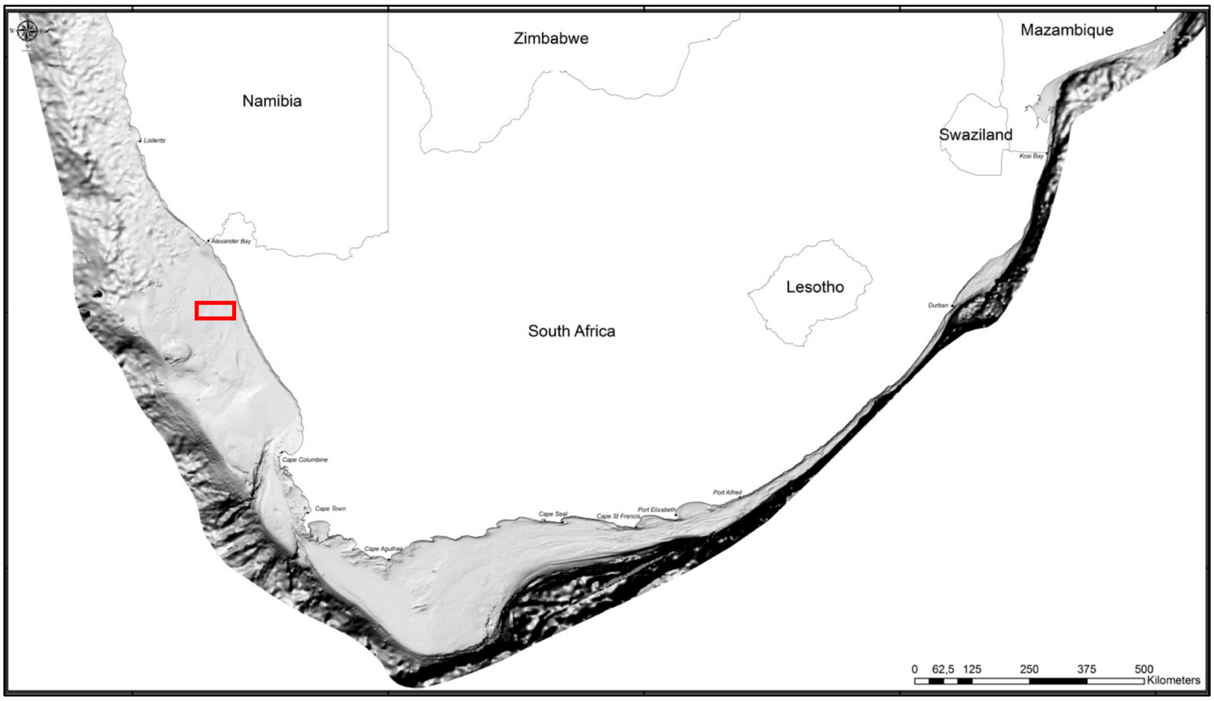


Figure 6: Shaded relief map showing the entire extent of the South African continental shelf. The approximate location of Concession Area 6C is marked by the red box (After De Wet 2013:106).

Until relatively recently there was little or no global understanding of the potential for, or access to, submerged prehistoric landscapes and sites on the continental shelf. Increasingly frequent discoveries in various parts of the world of drowned, formerly terrestrial landscapes, often as a result of development-led seabed surveys and sampling, is, however, providing increasing evidence for the survival of prehistoric archaeological sites on and within the current seabed.

Well-known examples of such evidence include archaeological material and late Pleistocene faunal remains recovered in the nets of fishing trawlers in the North Sea between the United Kingdom and the Netherlands throughout the 20th century (Peeters *et al*, 2009; Peeters, 2011) and the University of Birmingham’s archaeological interpretation of 3D seismic data, collected in the same area by the oil and gas industry, which has revealed well-preserved prehistoric landscape features across the southern North Sea (Fitch *et al*, 2005, Gaffney *et al*, 2010).

Since the University of Birmingham work there have been increasing numbers of reports of submerged archaeological sites and material, for example, Tizzard et al (2011) and Faught and Gusick (2011) and in Benjamin et al (2011).

Closer to home, there is archaeological evidence for a prehistoric human presence in what is now Table Bay. In 1995 and 1996 during the excavation of two Dutch East India Company shipwrecks, the *Oosterland* and *Waddinxveen*, divers recovered three ESA handaxes from the seabed under the wrecks.

The stone tools, which are between 300,000 and 1.4 million years old, were found at a depth of 7-8 m below mean sea level and were associated with Pleistocene sediments from an ancient submerged and infilled river channel. Their unrolled and unworn condition indicate that they had not been carried to their current position by the ancient river and suggests that they were found more or less where they were dropped ESA hominins more than 300,000 years ago (possibly during MIS 8 (~301,000 years ago) or MIS 12 (~478,000 years ago)), when the sea level was at least 10 m lower than it is today (Werz and Flemming, 2001; Werz *et al*, 2014).

Figure 7: Possible extent of the South African continental shelf c.137,000 years ago. The approximate location of Concession Area 6C is marked by the red box (After Franklin et al, 2015)

7.2.1 Submerged Prehistory Potential of Concession Area 6C

There have, to date, been no studies of the submerged prehistory of the West Coast but the terrestrial. archaeological evidence for a hominin presence along the coast in the vicinity of the study area during the ESA, MSA and LSA is plentiful.

Diepkloof Rock Shelter, inland of Elands Bay and south of the concession area, for example, contains evidence of a nearly continuous human occupation for nearly 85,000 years (see Parkington and Poggenpoel, 1987; Texier et al, 2010), while Elands Bay Cave, on the coast at the mouth of the Verloren Vlei, preserves archaeological evidence of the Pleistocene / Holocene transition during the LSA (Parkington, 1988).

Further south at Hoedjiespunt in Saldanha Bay, four hominid teeth, four or five small fragments of cranium, and two postcranial bones from up to two individuals have been found in an ancient hyena lair and are associated with uranium series dates on ostrich eggshell fragments which imply an ESA / MSA age of 130,000 to 180,000 years for these hominids (Berger and Parkington, 1996).

Nearby, at Churchaven on the Langbaan Lagoon a set of fossilized human footprints were discovered in an aeolianite slab in 1995. They are thought to be those of a female hominin (hence their nickname "Eve's footprints") and have been dated to approximately 117,000 years ago, during the MSA and very close to the start of the last glaciation when sea levels were starting to fall (see http://www.sawestcoast.com/fossileve.html).

LSA coastal shell middens are ubiquitous along the West Coast, as are numerous MSA shell middens; the latter being some of the earliest evidence in the world for the exploitation by our ancestors of marine resources.

Older, ESA lithics are also commonly found along on the West Coast where extensive evidence of an ESA presence in this landscape has been uncovered as a result of mining operations at Tronox Namaqua Sands (David Halkett, ACO Associates, pers. comm.; Orton, 2017). ESA material has also been reported from the Tormin Mineral Sands Operation south of the concession area (Halkett, D. 2023a, 2023b; Halkett, D., & Webley, L. 2016b).

As discussed in the previous section, the maximum sea level low stand during the Quaternary, when hominins would have been present in and on the South African landscape, was c. -120 m. Any areas of South Africa's current seabed shallower than c. -120 m thus have the potential to have been used by our ancestors and to preserve the archaeological evidence of that use.

As described by Pether (2026) in the sections above, a relatively small portion of the current seabed of Concession Area 6C would have been exposed as subaerial land surfaces for much of the last 200 000 years: for ~65 000 years during the MIS 6 ice age, and again between the start of the MIS 5a marine incursion at 80 000 years ago and about 9 000 years ago (see Figure 8).

However, the preservation potential of the Last Regression Sequence (LRS) terrestrial deposits that comprised this exposed landscape is low, as they would have mostly been eroded away and reworked as sea-level rose during the Last Transgression around 9 000 years ago.

Despite this, remnants of LRS deposits are known to occur in deep gullies, in sheltered areas landward of high bedrock ridges and in larger, deeper palaeo-channels, and it is possible that in such areas within Concession Area 6C, in situ archaeological material may survive.

According to Pether (2024), buried river palaeo-channels occur along the entire Namaqualand coast, although they are not shown on the geological maps, being covered by younger deposits. Examples of such channels are known at Kleinzee, directly north of the concession area where seabed sediment mapping by O'Shea (1971) indicates that a channel cut by the palaeo-Buffels River extends offshore to the west of Kleinzee.

Further up the coast, "submerged fluvial channels extending seawards from Langklip Bay and between Hondeklip Bay and the Swartlintjies River are clearly indicated by the bathymetry" (Hattingh, 2015:5).

Such channels and their associated sediment bodies have the potential for associated, now submerged, archaeological material and palaeo-environmental evidence and are illustrative of the likely situation with many of the other major rivers that feed into the Atlantic along the

West Coast and which have submerged palaeo-channels extending offshore, including the Olifants River to the south. These channels and the mobile sediment they contain are an important target for mineral prospecting.

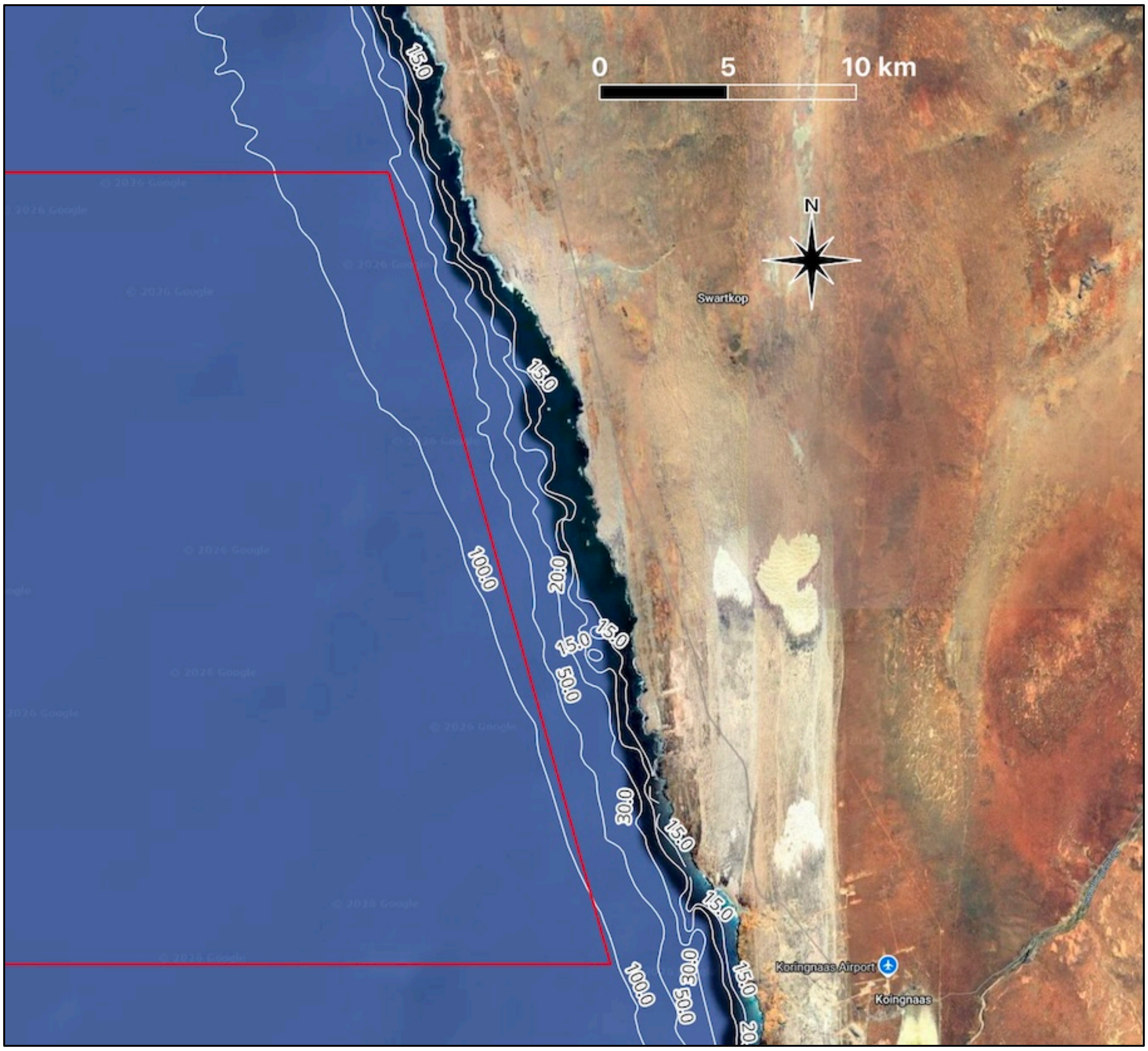


Figure 8: Inshore portion of Concession Area 6C (red polygon) showing the -100 m seabed contour. This provides an indication of the portion of the concession area within which there is the potential for submerged pre-colonial archaeological resources. (Source: Google Earth; SANHO).

As demonstrated in Table Bay, there is the potential for the occurrence of ancient, submerged archaeological material in association with palaeo-channels. This may take the form of archaeological artefacts or, where ancient alluvial sediment within these channels has survived post-glacial marine transgressions, there is the potential to recover palaeo-environmental data (pollens, foraminifera and diatoms, for example) which can contribute contextual information to our understanding of the ancient human occupation of South Africa.

Along most of the West Coast, however, as the rising sea during the Last Marine Transgression eroded terrestrial sediments, stone age sites present within such deposits are likely to have been destroyed and their lithic component reworked to form part of seabed gravels.

Ex situ stone age artefacts may thus be present within the surficial seabed sediments within Concession Area 6C, that will be recovered during seabed sampling associated with the prospecting activities.

7.3 Maritime History of the South African Coast

In 1498 the Portuguese explorer Vasco da Gama finally pioneered the long-sought sea route around Africa from Europe to the East. Since then, the southern tip of the African continent has played a vital role in global economic and maritime affairs, and until the opening of the Suez Canal in 1869, represented the most viable route between Europe and the markets of the East (Axelson, 1973; Turner, 1988; Gribble, 2002; Gribble and Sharfman, 2013).

The South African coast is rugged, and the long fetch and deep offshore waters mean that the force and size of seas around the South African coast are considerable, a situation exacerbated by prevailing seasonal winds.

The geographical position of the South African coast on the historical route to the East and the physical conditions mariners could expect to encounter in these waters have, in the last five centuries, been responsible for the large number of maritime casualties which today form the bulk of South Africa’s maritime and underwater cultural heritage (Gribble, 2002).

At least 2,900 vessels are known to have sunk, or been wrecked, abandoned or scuttled in South African waters since the early 1500s. More than 1,900 of these wrecks are more than 60 years old and are thus protected by the NHRA as archaeological resources. This list of casualties is not believed to be complete and certainly does not include the as yet unproven potential for shipwrecks and other sites that relate to pre-European, Indian Ocean maritime exploration, trade and interactions along the South African east coast.

Da Gama’s maritime incursion into the Indian Ocean laid the foundation for more than 500 years of subsequent European maritime activity in the waters off the South African coast (Cliff, 2012). The Portuguese and other European nations who followed their lead around the Cape and into the Indian Ocean, however, joined a maritime trade network that was thousands of years old and in which east and south-east Africa was an important partner.

For historical reasons, the earliest known South African wrecks are Portuguese, dating to the sixteenth century when that country held sway over the route to the East. Due to the later, more prolonged ascendancy of first the Dutch and then the British in European trade with the East and control at the Cape, most wrecks along the South African coast are Dutch and British. However, at least 36 other nationalities are represented amongst the other wrecks that litter the coast.

These more than 2,900 historical shipwrecks are a thus huge, cosmopolitan, repository of information about mainly global maritime trade during the last five centuries and potentially much further back into the past. These sites contain a wealth of cultural material associated with that trade and clues to the political, economic, social and cultural changes that accompanied this trade, and which contributed to the creation of the modern world.

7.3.1 Maritime Heritage of the West Coast and Concession Area 6C

The maritime history of the West Coast dates to almost the early days of the Dutch settlement in Table Bay. The Dutch settlers were quick to recognise and exploit the rich marine resources of the West Coast and fishing and sealing flourished, with the catches transported down the coast to supply the VOC settlement in Table Bay.

This industry led to the development of fishing villages at Saldanha Bay and Lamberts Bay: the former, together with places like Elands Bay, also later becoming ports for the export of grain and other produce from the Swartland and Cederberg (Ingpen 1979).

During the early nineteenth century the West Coast islands became the focus of an international 'white gold' rush to exploit their rich guano resources (Watson, 1930; Snyders, 2011). The guano was soon depleted but the discovery of copper deposits in Namaqualand and the Richtersveld led to the use of Alexander Bay, Robbe Bay (now Port Nolloth) and Hondeklip Bay as established anchorages by the early 1850s and the development of local, coasting shipping services to support this new industry (The Nautical Magazine and Naval Chronicle 1855: 297-303; Ingpen 1979).

Except for Saldanha Bay, the West Coast historically lacked good harbours and combined with the regular coastal fogs, a largely rocky shoreline and dangerous inset currents this took its toll on shipping over the years.

According to the available sources, there are at least 89 shipping casualties recorded between the Berg and Orange Rivers, many of which were vessels involved in coastal trade and fishing.

Two of these maritime casualties are recorded as having taken place inshore of Concession Area 6C while several others are located on the coast to the north and south of the concession area. These wrecks listed in Table 3 and shown on Figure 9.

Table 3: Shipwrecks in the vicinity of Concession Area 6C

Ship Name	Approx Position	Place	Event Type	Vessel Category	Year	Notes
Arosa	-30.0358 S / 17.1622 E	40km south of Kleinsee	Wrecked	Steel Freighter	1976	It was still visible on the rocks in 1987and 1995
Border	-29.9387 S / 17.1245 E	Naganas Point / Elands Klip	Wrecked	Motor Coaster	1947	Lost just south of Port Nolloth in dense fog. No lives were lost.
Wrecks to the north and south of Concession Area 6C						
Aristea	-30.3454 S 17.2783 E/	4.8km south of Hondeklip Bay	Wrecked	Motor Trawler	1945	Wreck visible on beach
Bechuana	-29.7238 S / 17.0540 E	48.3km south of Port Nolloth	Wrecked	Coasting Freighter	1950	The crew got ashore without much difficulty once the vessel had been hurled up on the beach on her side
Dundoon	-29.6963 S / 17.0428 E	3km south of Kleinsee	Wrecked	Wooden trawler	1949	Engine remains at the wreck site
Dunotter	-29.6534 S / 17.0314 E	Approximately 5km north west of Kleinsee	Wrecked	Steel trawler	1950	Parts of her steel hull and her engine are still occasionally visible on the beach below the high water mark

Luna	-30.3167 S / 17.2704 E	Near Hondeklip Bay	Wrecked	Wooden Steam Coaster	1945	Ran aground in fog and become total loss with all hands.
Natal	-30.3155 S / 17.2708 E	West of Espiegle Bay	Wrecked	Schooner	1852	Wrecked in a south easterly gale. No lives lost.
Piritiny	-29.7105 S / 17.0527 E	Schulp Point, south of Kleinsee	Wrecked	Steel Steamship	1943	Ran ashore in bad weather and broke up
Poseiden Cape	-29.6747 S / 17.0396 E	Rocks off Kleinsee	Wrecked	Diving Maintenance Support Ship	1985	Dragged her anchors while laying moorings. Came ashore and became a total loss.
Runnymede	-29.6079 S / 17.0053 E	Ostara Rock, 45 km south of Port Nolloth	Sank	Steel Coaster	1923	Foundered. Crew reached Port Nolloth in the boats.

The two historical wrecks recorded shoreward of the eastern boundary of the concession area are the *Arosa*, wrecked in 1976 and the *Border*, lost in 1947. The wreck of the *Arosa* is not yet 60 years of age so is not yet protected by the NHRA. The *Border*, however, is protected.

Historical records indicate that both the *Arosa* and the *Border* were wrecked on the coast, and this is confirmed by their remains which are still visible on the beach. Neither wreck is thus within Concession Area 6C, and both have been scoped out of this assessment as potential impact receptors.

The positions of the other wrecks listed in Table 3 are all sufficiently well-established or distant from the concession area that they can be ruled out as being present in Concession Area 6C, and they too, have been scoped out of this assessment.

Lastly, it must be stated that although unlikely, the possibility does exist for the remains of currently unknown and unrecorded wrecks to be present in the concession area. The historical records contain many references to vessels that were lost without trace between their points of departure and arrival. Where survivors of such events were subsequently rescued, the loss was recorded, but in many cases, vessels simply never arrived at their destination and could thus lie anywhere along their intended route.

The potential for the occurrence of such unrecorded wrecks was illustrated in 2008 when a 16th century Portuguese wreck, since identified as the Bom Jesus, was unexpectedly found during the diamond mining south of Oranjemund in Namibia (see Alves 2011).

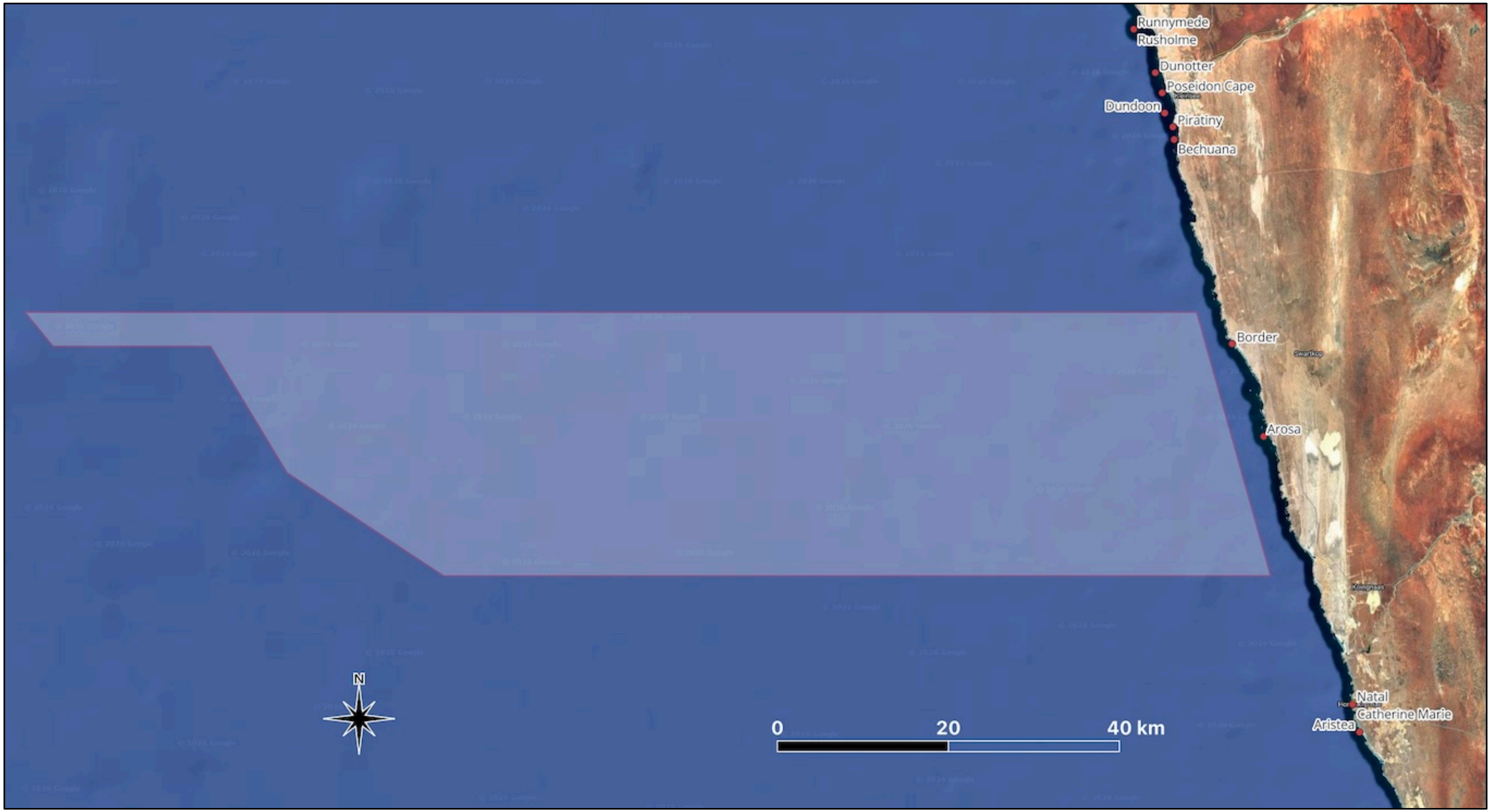


Figure 9: Known historical wrecks in the vicinity of Concession Area 6C (Source: Google Earth).

8 IMPACT ASSESSMENT

Heritage resources are fragile, finite and non-renewable, and unlike living resources cannot recover if damaged by human activities such as seabed prospecting. The identification, assessment and, where necessary, the mitigation of impacts on such resources that arise from human activity is therefore an essential part of managing such activities.

The approach of this impact assessment is, therefore, to take the project component specifications set out in Section 3 above and assess worst case scenarios.

This impact assessment aims to:

- Identify those <u>project activities and components</u> of the proposed seabed sampling in Concession Area 6C which may pose risks to heritage resources.
- Identify and define the <u>likely footprint</u> of these risks and impacts.
- Identify and describe the likely <u>risks and impacts</u> (negative and/or positive, including cumulative impacts if relevant) and their <u>significance</u>, during prospecting.
- Makes recommendations for <u>measures to manage and mitigate</u> any negative impacts on heritage resources.

Impacts are assessed through the consideration of extent, intensity, duration, and the probability of the impact occurring. Consideration is also given to the degree to which impacts may cause irreplaceable loss of resources, can be avoided, can be reversed, and the degree to which they can be mitigated.

The methodology applied in this impact assessment is set out below.

8.1 Impact Assessment Methodology

The significance of all potential impacts that would result from the proposed project is determined to assist decision-makers. The **significance** of an impact is defined as a combination of the **consequence** of the impact occurring and the **probability** that the impact will occur. The significance of each identified impact was thus rated according to the methodology set out below:

Step 1 – Determine the **consequence** rating for the impact by determining the score for each of the three criteria (A-C) listed below and then **adding** them. The rationale for assigning a specific rating, and comments on the degree to which the impact may cause irreplaceable loss of resources and be irreversible, must be included in the narrative accompanying the impact rating:

Rating	Definition of Rating	Score
A. Extent – the area over which the impact will be experienced		
Local	Confined to project or study area or part thereof	1
Regional	The region (e.g. the whole of Eastern Cape coast)	2

(Inter) national	Significantly beyond East London and adjacent land areas	3
B. Intensity – the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration – the time frame for which the impact will be experienced and its reversibility		
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Permanent	The impact is irreversible	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Combined Score (A+B+C)	**3 – 4**	**5**	**6**	**7**	**8 – 9**
Consequence Rating	Very low	Low	Medium	High	Very high

Step 2 – Assess the **probability** of the impact occurring according to the following definitions:

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

Step 3 – Determine the overall **significance** of the impact as a combination of the **consequence** and **probability** ratings, as set out below:

		Probability			
		Improbable	**Possible**	**Probable**	**Definite**
Consequence	**Very Low**	INSIGNIFICANT	INSIGNIFICANT	VERY LOW	VERY LOW
	Low	VERY LOW	VERY LOW	LOW	LOW
	Medium	LOW	LOW	MEDIUM	MEDIUM
	High	MEDIUM	MEDIUM	HIGH	HIGH
	Very High	HIGH	HIGH	VERY HIGH	VERY HIGH

Step 4 – Note the **status** of the impact (i.e. will the effect of the impact be negative or positive?)

Step 5 – State the level of **confidence** in the assessment of the impact (high, medium or low).

Impacts are also considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The prescribed system for considering impacts status and confidence (in assessment) is laid out in the table below. Depending on the data available, a higher level of confidence may be attached to the assessment of some impacts than others. For example, if the assessment is based on extrapolated data, this may reduce the confidence level to low, noting that further ground-truthing is required to improve this.

Confidence rating	
Status of impact	+ ve (beneficial) or – ve (cost)
Confidence of assessment	Low, Medium or High

The significance rating of impacts is considered by decision-makers, as shown below. Note, this method does not apply to minor impacts which can be logically grouped into a single assessment.

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity.
- **HIGH**: the potential impact **will** affect a decision regarding the proposed activity.
- **VERY HIGH**: The proposed activity should only be approved under special circumstances.

Step 6 – Identify and describe practical **mitigation** and **optimisation** measures that can be implemented effectively to reduce or enhance the significance of the impact. Mitigation and optimisation measures must be described as either:

- **Essential**: must be implemented and are non-negotiable; and
- **Best Practice**: must be shown to have been considered and sound reasons provided by the proponent if not implemented.

Essential mitigation and optimisation measures must be inserted into the completed impact assessment table. The impact should be re-assessed with mitigation, by following Steps 1-5 again to demonstrate how the extent, intensity, duration and/or probability change after implementation of the proposed mitigation measures.

Step 7 – Prepare a summary table of all impact significance ratings.

Finally, indicate whether the proposed development alternatives are environmentally suitable or unsuitable in terms of the respective impacts assessed by the relevant specialist and the environmentally preferred alternative.

8.2 Potential Impacts of Prospecting on Heritage Resources

The target resource of the proposed mineral prospecting is seabed sediments which have the potential to contain palaeontological resources, submerged (previously terrestrial) archaeological sites and artefacts, and maritime archaeological (mainly shipwreck) sites and materials. The disturbance and/or removal of such sediments during prospecting can damage or destroy heritage resources where they are present.

The exception may be shipwrecks, the component parts of which tend to be large enough to be identified in advance of, and avoided during prospecting activities.

Impacts to heritage resources are likely to arise from the following proposed prospecting activities in Concession Area 6C:

- Grab sampling;
- Core sampling, and
- Drill sampling.

The geophysical survey programme will have no direct impact on heritage resources.

8.3 Impact Assessment: Palaeontology

Fossils are rare objects, often preserved due to unusual circumstances. This is particularly applicable to vertebrate fossils (bones), which tend to be sporadically preserved and have high value with respect to palaeoecological and biostratigraphic (dating) information. Such fossils are non-renewable resources.

Provided that no subsurface disturbance occurs, the fossils remain sequestered. The absence of management and operator mitigatory actions to be alert for fossils and retrieve them will result in their loss. This loss of the opportunity to recover fossils and record their contexts when exposed at a particular site is a negative, irreversible impact.

If mitigatory efforts are made to watch out for and rescue the fossils then the impact is positive for palaeontology. However, there remains a medium to high risk of valuable fossils being lost in spite of management actions to mitigate such loss. The fossils may simply not be noticed or not recognized. Even the most diligent attempts at mitigation can only hope to acquire some fraction of the fossils. This is particularly the case if the fossils are sparsely distributed in the deposits, which is generally the case for scientifically-valuable fossil bone material. A misperception exists that if fossils are sparse in a deposit then the intensity of impact will be low. This is not the case as it is the valuable fossils that are usually scarce, such as fossil bones. The very scarcity of such fossils makes for the added importance of watching for them.

The proposed grab samples are purposed for obtaining the upper, modern fauna and are unlikely to capture fossils which are usually lower down. Notwithstanding, the grabs may capture poorly-known modern species.

In the vibracores the small volumes involved greatly reduce to likelihood of capturing the sparse fossils reworked from the older, pre- late Quaternary formations and the “extralimitals” in the Last Transgression Sequence. However, should extralimital Subantarctic and Agulhas species occur in the cores they are more important specimens than those selected from the loose, mixed shells crossing the oversize screens on sampling/mining vessels, as they have context in the geological and faunal succession in the core and the expense to have specimens radiocarbon dated is more worthwhile.

The drillship sampling involves a considerable volume of the shelf deposits (up to 1500 sites). For the most part the excavated material is the Last Transgression Sequence deposits with expected “subfossil” extant shell species and a ‘sprinkling” of scientifically important extralimital species and rare reworked old fossil shells, bones and teeth in the gravels.

8.3.1 Extent of Impacts

During prospecting, the fossil content of a prescribed volume of deposit is destroyed, which is the physical extent of the impact. The extent of impacts to palaeontogical material arising from the prospecting in Concession Area 6C will, thus, be **local**.

8.3.2 Duration of Impacts

The impact of both the finding or the loss of fossils is **permanent**. Destroyed fossils are lost, while found fossils must be preserved for posterity.

8.3.3 Intensity of Impact

The intensity or magnitude of the potential impacts of prospecting activities in Concession Area 6C on fossil resources is determined by the palaeontological sensitivity of the affected formations or fossil types – i.e. the potential scientific value of the fossils assessed against the degree or volume of disturbance.

The intensity of impacts for each of the palaeontological receptors is described by Pether (2026) as follows:

- **Cretaceous Fossil Wood**: During sampling on the middle shelf, pebbles, cobbles and small boulders of both silicified wood and black lignitic wood, which occur in the Latest Quaternary basal gravels, are fairly routinely sucked up from the seabed, pass rapidly over the oversize screen and then are disposed of overboard again. Although the fossil wood is not *in situ* in the source formation, the specimens are accorded a **moderate** palaeontological sensitivity due to the scientific value.
- **Cenozoic Shelly Macrofauna**: The moulds of dissolved shells in cobbles and boulders derived from Miocene and Eocene formations preserve the external sculpture

and are generally identifiable. The loose internal moulds of shells such as gastropod coils and bivalve casts (endocasts, also called steinkerns), which are quite common in the Quaternary gravels, are less easy to identify when worn, unless of taxa with very distinctive shapes. In rare places on the middle shelf practically pristine fossil shells are drilled up in from sample sites penetrating Miocene footwall. The impact of sampling on the Cenozoic shelly macrofauna is considered to be **moderate**.

- **Fossil Bones and Teeth**: This category includes fossil bones and teeth of any origin as there is no purpose for distinctions when they must be captured before going overboard. Recent “fresh” bones such as those of seals and fish, and pieces of freshly-broken whalebone ribs, are common and are excluded. This fossil material is phosphatized (petrified) to various degrees and probably also worn by transport and/or pitted by boring organisms. This material is scarce, but the large volumes involved increase the probability that some will be encountered and could be of **high** scientific value.
- **Shells from the Last Transgression Sequence**: Quaternary fossil shell assemblages consist mainly of well-known, usual taxa and it is the unexpected, out of range or unknown shell species which are important. The concern here are shell species which are not typical of the normal faunal assemblages of the Namaqua shelf and are generally sparse, although several may occur in the same area. It is important to obtain a comprehensive sample of the Algoa species extralimital occurrences for future study. In addition to radiocarbon dating the incursions on Agulhas influence, the individual shells are snapshot archives of the palaeoceanographic conditions at the time, as revealed by incremental analyses of the shell stable isotopes and trace elements. Sampling in Concession Area 6C has a strong potential to yield fossil shells of extralimital Algoa species and is accorded **moderate** palaeontological sensitivity.

8.3.4 Reversibility

Palaeontological resources are unique and their loss is **irreversible**.

8.3.5 Irreplaceability

Without mitigation and rescue of fossils there will be a **complete loss of resources** within the footprints of sampling and mining. Valuable fossils will be lost despite management actions to mitigate such loss.

8.3.6 Impact Summary Tables: Palaeontology

The following impact tables primarily refer to drillship sampling.

Table 4: Impact Assessment - Cretaceous Fossil Wood

	Extent	Duration	Intensity	Consequ.	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Permanent 3	Medium 2	Medium 6	Probable	MEDIUM	-‘ve	M

Essential mitigation measures • Prospecting EMPr must include provisions for the collection of representative examples of the fossils. • Geological staff involved in logging to be informed of the need to watch for fossil wood and rescue such from the gravel oversize screen. • Fossils to be labelled and bagged, with recording of context data, and stored. • Appointed palaeontologist to evaluate fossils collected and compile report for company and SAHRA.								
With mitigation	Local 1	Permanent 3	Medium 2	Medium 6	Probable	MEDIUM	+'ve	M

Table 5: Impact Assessment - Cenozoic Shelly Macrofauna

	Extent	Duration	Intensity	Consequ.	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Permanent 3	Medium 2	Medium 6	Probable	MEDIUM	-'ve	M
Essential mitigation measures • Prospecting EMPr must include provisions for the collection of representative examples of the fossils. • Geological staff involved in logging to be informed of the need to watch for fossil shells and rescue such from the gravel oversize screen. • Fossils to be labelled and bagged, with recording of context data, and stored. • Appointed palaeontologist to evaluate fossils collected and compile report for company and SAHRA.								
With mitigation	Local 1	Permanent 3	Medium 2	Medium 6	Probable	MEDIUM	+'ve	M

Table 6: Impact Assessment - Fossil Bones and Teeth

	Extent	Duration	Intensity	Consequ.	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Permanent 3	High 3	High 7	Improbable	MEDIUM	-'ve	M
Essential mitigation measures • Prospecting EMPr must include provisions for the collection of representative examples of the fossils. • Geological staff involved in logging to be informed of the need to watch for fossil bones and teeth and rescue such from the gravel oversize screen. • Fossils to be labelled and bagged, with recording of context data, and stored. • Appointed palaeontologist to evaluate fossils collected and compile report for company and SAHRA.								
With mitigation	Local 1	Permanent 3	High 3	High 7	Probable	MEDIUM	+'ve	M

Table 7: Impact Assessment - Shells from the Last Transgression Sequence

	Extent	Duration	Intensity	Consequ.	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Permanent 3	Medium 2	Medium 6	Possible	LOW	-'ve	M
Essential mitigation measures • Prospecting EMPr must include provisions for the collection of representative examples of the fossils. • Geological staff involved in logging to be informed of the need to watch for unusual shells and rescue such from the gravel oversize screen, as well as from grab samples and vibracores. • Fossils to be labelled and bagged, with recording of context data, and stored. • Appointed palaeontologist to evaluate fossils collected and compile report for company and SAHRA.								
With mitigation	Local 1	Permanent 3	Medium 2	Medium 6	Possible	LOW	+'ve	M

8.4 Impact Assessment: Submerged Prehistory

The past use by our hominin ancestors of the exposed continental shelf is beyond doubt and archaeological evidence of the occupation, through the ESA, MSA and LSA, of the terrestrial hinterland of Concession Area 6C, suggests that it is likely that the material evidence of the same, now submerged terrestrial archaeological occupation of the shallow continental shelf will be found within the seabed sediments of the concession area.

The evidence of this presence is possible where the water depth is less than c. 120 m and where archaeological material has survived post-glacial marine transgressions. Although some such material may be found in situ, it is more likely that it will be found reworked within seabed sediments and survive as isolated, particularly stone artefacts.

Prospecting activities will have a direct impact on seabed sediments. Impacts will be **local**, confined to the footprint of the activity, and of **medium** intensity. The duration of any impacts will be irreversible and **permanent** and should there be archaeological material in the affected sediments this will be disturbed and may be destroyed.

The assessment of impact significance for submerged prehistoric archaeology is **medium**.

Table 8: Impact Assessment –Submerged Prehistory

	Extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	Medium 2	Permanent 3	Medium 6	Possible	MEDIUM	– ve	Medium
Essential mitigation measures: • Contractors and Trans Atlantic Diamonds staff are informed during Environmental Awareness Training of the need to watch for prehistoric archaeological material during the processing of prospecting grab, core and drill samples; • Contractors and Trans Atlantic Diamonds staff are provided with information about how to identify prehistoric stone artefacts; • The EMPr for Concession Area 6C includes provision for the collection of pre-colonial archaeological artefacts if these are found during the course of prospecting activities or the processing of seabed samples; • When a collection of archaeological material has been accumulated, the appointed archaeologist undertakes the identification and evaluation of the material and compiles a report for submission to SAHRA.								
With mitigation	Local 1	Medium 2	Permanent 3	Medium 6	Possible	MEDIUM	+ ve	Medium

8.5 Impact Assessment: Maritime Archaeology

Based on the discussion above of maritime heritage resources in and around Concession Area 6C, there appears to be no evidence for historical wrecks in the concession area.

The possibility that currently unknown historical wrecks or maritime debris are present on the seabed in Concession Area 6C is also so low that it has been discounted.

Maritime archaeology has, therefore, been **scoped out** of this assessment

Should an unknown wreck or shipwreck material be discovered in the concession area during prospecting, the position of the find must be recorded and must immediately be reported to SAHRA who will make arrangements to assess the significance of the find and decide on how best to deal with it.

9 CUMULATIVE IMPACTS

For the purposes of this report, cumulative impacts are defined as 'direct and indirect impacts that act together with existing or future potential impacts of other activities or proposed activities in the area / region that affect the same resources and / or receptors'.

For the most part, cumulative effects or aspects thereof are too uncertain to be quantifiable, due mainly to a lack of data availability and accuracy. This is particularly true of cumulative effects arising from potential or future projects, the design or details of which may not be finalised or available and the direct and indirect impacts of which have not yet been assessed.

For practical reasons, the identification and management of cumulative impacts are limited to those effects generally recognised as important on the basis of scientific concerns and/or concerns of affected communities.

Given the above, the activities that potentially have cumulative impacts with the prospecting activities proposed in Concession Area 6C, and which are considered in the cumulative impact assessment, have been limited to current offshore prospecting or mining in the surrounding concession areas.

9.1 Cumulative Impact Assessment

Given the nature of seabed heritage resources and the extent of our knowledge about their occurrence and distribution, an assessment of the cumulative impact of current and future seabed activities on these resources in the area surrounding Concession Area 6C can only be qualitative and descriptive.

In respect of palaeontology, Pether (2026) states that the cumulative result of offshore prospecting in Concession Area 6C and surrounding concession areas is the inevitable and permanent loss of fossils and associated scientific knowledge.

If, however, attention is given across projects in the area to mitigation and the successful rescue of a representative sample of fossils, the accumulation of scientific evidence and knowledge about the stratigraphy of the continental shelf formations, their palaeoenvironments, past faunas and their ages, and sea-level history, this is likely to outweigh the negative impacts, and the cumulative effects are likely to be reduced.

Although there is very little concrete evidence for the distribution of submerged prehistoric sites and materials in and on the seabed around the South African coast, it is clear these sites and material will exist. Using the terrestrial archaeology of the West Coast, and the archaeological evidence generated from work associated with the mining operations at Tronox Namakwa Sands and Tormin mines, for example, as proxies for the spatial distribution of sites on the now inundated continental shelf, it is also clear that significant archaeological sites and material will be highly localised and most of the seabed will not contain such material.

Thus, while other current and future seabed activities, such as prospecting or mining, which disturb the seabed have the potential to impact submerged prehistoric sites and materials, the likely low density of such material in the seabed suggests that impacts are unlikely and will be of low cumulative significance.

With respect to potential cumulative impacts on historical shipwrecks, the discussion above indicates that this area of South Africa's West Coast has relatively few wrecks, when compared to places like Table Bay which alone had more than 400 maritime casualties. The majority of West Coast wrecks are located close to the coast, and cumulative impacts arising from seabed prospecting are thus potentially more of a risk in the A-concession areas.

Generally, however, wherever they occur, historical wrecks and related maritime archaeological debris are avoidable, through the prior collection and analysis of geophysical data, and actively avoided by seabed activities such as prospecting because of potential damage they can cause to sampling and other seabed machinery.

Impacts on historical shipwrecks arising from seabed activities are likely to be accidental where they do occur, and once a wreck has been encountered on the seabed it is likely to be excluded from the area of activities as an operational obstruction or risk.

Cumulative impacts on maritime archaeological resources, principally historical shipwrecks, arising out of current and future seabed activities in the area surrounding Concession Area 6C is, therefore, unlikely and cumulative impact significance is assessed to be low.

10 CONCLUSIONS AND RECOMMENDATIONS

This assessment of the heritage resources of Concession Area 6C indicates that there is the potential for the occurrence of palaeontological material, some limited potential for submerged prehistoric archaeological sites or material and a very low likelihood of shipwreck sites or material being present in the seabed sediments to be affected by proposed prospecting activities.

Because of the non-renewable nature of heritage resources, avoidance is the preferred mitigation option, and while this is possible in the case of shipwreck sites, it is unlikely to be possible to achieve in respect of palaeontological or submerged prehistoric archaeological material.

Although seabed prospecting in Concession Area 6C may result in the destruction of palaeontological and submerged prehistoric archaeological resources, as Pether (2026) states, it is also an opportunity to obtain potentially significant fossils and to provide concrete evidence of the pre-colonial occupation of the continental shelf during sea level lowstands in the last c.1 million years.

The discovery of an important fossil or pre-colonial archaeological artefacts can also generate favourable publicity for Trans Atlantic Diamonds, as an illustration of the potential for the co-operative advancement of science and knowledge.

It is recommended, therefore, that the Environmental Mamagement Programme (EMPr) for the proposed prospecting, includes a requirement:

- For the collection of fossils and pre-colonial archaeological material from the recovered prospecting samples; and
- That all relevant Trans Atlantic Diamonds staff and contractors are informed during Environmental Awareness Training of the need to watch for such material during the processing prospecting samples, and that they are provided with information about how to identify both fossils and prehistoric stone artefacts.

In respect of grab and vibrocore samples, fossil or pre-colonial archaeological material may be found during the processing of the samples. This material may be obvious, such as petrified bone and teeth and shell casts, usually phosphatic or flaked stone.

All recovered material of potential interest must have the details of context recorded and be kept for identification by an appropriate palaeontological or archaeological specialist and if significant, to be deposited in a curatorial institution such as the Iziko South African Museum.

The identification of extralimital, Agulhas/Algoa “subfossil” shell species in the loose shells of the Last Transgression Sequence requires a level of seashell knowledge. The best outcome for a set of cores is that they are the subject of a detailed study, such as for a B.Sc. Honours or M.Sc. project, with radiocarbon dates. It is possible that a core or two might intersect rarely preserved lagoonal deposits which are important for providing points on the sea-level curve applicable to the West Coast.

In respect of drill samples, as part of the normal sampling process, the material crossing the oversize screen must be monitored for the occurrence of the various fossil types and for pre-colonial lithic artefacts. Where noted, these should be collected for later identification and evaluation.

Data to be recorded during fossil and artefact collection must include the following: date, vessel, company name, sample number, collector’s name, position (co-ordinates), water depth, sample subsurface depth and a brief description and photographs of the recovered material. This information should be accompanied by:

- A copy of the graphic log of the sample drill hole showing the vertical sequence of units and the estimated location of the fossil in the sequence; and
- A map of the fossil finds in the particular sampling area, such as a contoured multibeam bathymetric image showing the context of samples in relation to the bedrock topography and sediment bodies.

During all operations, personnel can send queries and images by email to an appointed palaeontologist for evaluation and prompt feedback.

Collected samples are to be temporarily stored by Trans Atlantic Diamonds.

When a collection of fossil or pre-colonial archaeological material has been accumulated, the appointed palaeontologist and/or archaeologist should undertake the identification and evaluation of the material and compile the report for submission to SAHRA. The Environmental Manager/Officer) is to liaise with the appointed palaeontologist and/or archaeologist on the progress of the fossil and artefact collection and the scheduling of the evaluation.

Please note that the prospecting company must, in advance of prospecting activities, apply to SAHRA for a general permit to destroy, damage, excavate, disturb and collect fossils identified during prospecting, as per the NHRA.

If shipwreck material is identified in the concession area, the find must immediately be reported to SAHRA who will make arrangements to assess the significance of the find and decide on how best to deal with it.

10.1 Acceptability of the Proposed Activity

It is our reasoned opinion that provided the recommendations to mitigate and offset potential impacts are implemented, the proposed prospecting in Concession Area 6C is likely to have relatively minor impacts on palaeontological, submerged prehistoric and maritime and underwater cultural heritage resources and can be considered to be archaeologically and palaeontologically acceptable.

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APPENDIX 1: SPECIALIST CV – JOHN GRIBBLE

Name:	John Gribble
Profession:	Archaeologist
Date of Birth:	15 November 1965
Parent Firm:	ACO Associates cc
Position in Firm:	Senior Archaeologist
Years with Firm:	5+
Years of experience:	30+
Nationality:	South African
HDI Status:	n/a

Education:

1979-1983	Wynberg Boys' High School (1979-1983)
1986	BA (Archaeology), University of Cape Town
1987	BA (Hons) (Archaeology), University of Cape Town
1990	Master of Arts, (Archaeology) University of Cape Town

Employment:

- ACO Associates, Senior Archaeologist and Consultant, September 2017 – present
- South African Heritage Resources Agency, Manager: Maritime and Underwater Cultural Heritage Unit, 2014 – 2017 / Acting Manager: Archaeology, Palaeontology and Meteorites Unit, 2016-2017
- Sea Change Heritage Consultants Limited, Director, 2012 – present
- TUV SUD PMSS (Romsey, United Kingdom), Principal Consultant: Maritime Archaeology, 2011-2012
- EMU Limited (Southampton, United Kingdom), Principal Consultant: Maritime Archaeology, 2009-2011
- Wessex Archaeology (Salisbury, United Kingdom), Project Manager: Coastal and Marine , 2005-2009
- National Monuments Council / South African Heritage Resources Agency, Maritime Archaeologist, 1996-2005
- National Monuments Council, Professional Officer: Boland and West Coast, Western Cape Office, 1994-1996

Professional Qualifications and Accreditation:

- Member: Association of Southern African Professional Archaeologists (No. 043)
- Principal Investigator: Maritime and Colonial Archaeology, ASAPA CRM Section
- Field Director: Stone Age Archaeology, ASAPA CRM Section
- Member: Chartered Institute for Archaeologists (CIfA), United Kingdom
- Class III Diver (Surface Supply), Department of Labour (South Africa) / UK (HSE III)

Experience:

I have more than 30 years of combined archaeological and heritage management experience. After completing my postgraduate studies, which were focussed on the vernacular architecture of the West Coast, and a period of freelance archaeological work in South Africa and aboard, I joined the National Monuments Council (NMC) (now the South African Heritage Resources Agency (SAHRA)) in 1994. As the Heritage Officer: the Boland I was involved in day to day historical building control and heritage resources management across the region. In 1996 I become the NMC's first full-time maritime archaeologist in which role was responsible for the management and protection of underwater cultural heritage in South Africa under the National Monuments Act, and subsequently under the National Heritage Resources Act.

In 2005 I moved to the UK to join Wessex Archaeology, one of the UK's biggest archaeological consultancies, as a project manager in its Coastal and Marine Section. In 2009 I joined Fugro EMU Limited, a marine geosurvey company based in Southampton to set up their maritime archaeological section. I then spent a year at TUV SUD PMSS, an international renewable energy consultancy based in Romsey, where I again provided maritime archaeological consultancy services to principally the offshore renewable and marine aggregate industries.

In August 2012 I set up Sea Change Heritage Consultants Limited, a maritime archaeological consultancy. Sea Change provides archaeological services to a range of UK maritime sectors, including marine aggregates and offshore renewable energy. It also actively pursues opportunities to raise public awareness and understanding of underwater cultural heritage through educational and research projects and programmes, including some projects being developed in South Africa.

Projects include specialist archaeological consultancy for more than 15 offshore renewable energy projects and more than a dozen offshore aggregate extraction licence areas.

In addition to managing numerous UK development-driven archaeological projects, I have also been involved in important strategic work which developed guidance and best practice for the offshore industry with respect to the marine historic environment. This has included the principal authorship of two historic environment guidance documents for COWRIE and the UK renewable energy sector, and the development of the archaeological elements of the first Regional Environmental Assessments for the UK marine aggregates industry. In 2013-14 I was lead author and project co-ordinator on the Impact Review for the United Kingdom of the 2001 UNESCO Convention on the Protection of the Underwater Cultural Heritage. In 2016 I was co-author of a Historic England / Crown Estate / British Marine Aggregate Producers Association funded review of marine historic environment best practice guidance for the UK offshore aggregate industry.

I returned to South African in mid-2014 where I was re-appointed to my earlier post at SAHRA: Manager of the Maritime and Underwater Cultural Heritage Unit. In July 2016 I was also appointed Acting Manager of SAHRA's Archaeology, Palaeontology and Meteorites Unit.

I left SAHRA in September 2017 to join ACO Associates as Senior Archaeologist and Consultant.
I have been a member of the ICOMOS International Committee for Underwater Cultural Heritage since 2000 and have served as a member of its Bureau since 2009.

I have been a member of the Association of Southern African Professional Archaeologists for more than twenty years and am accredited by ASAPA's CRM section. Since 2010 I have been a member of the UK's Joint Nautical Archaeology Policy Committee.

I am a member of the Advisory Board of the George Washington University / Iziko Museums of South Africa / South African Heritage Resources Agency / Smithsonian Institution 'Southern African Slave Wrecks Project' and serve on the Heritage Western Cape Archaeology, Palaeontology and Meteorites Committee.

Books and Publications:

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APPENDIX 2: PALAEONTOLOGICAL IMPACT ASSESSMENT BY JOHN PETHER

(See separate pdf file)